DOCTOR OF PHILOSOPHY

Assessing and sentencing illegal behaviours in conservation

St John, Freya A. V.

Award date:
2012

Awarding institution:
Bangor University

Assessing and sentencing illegal behaviours in conservation

A thesis for the degree of Doctor of Philosophy

By

Freya A. V. St. John BSc (Hons), M.Sc. (Distinction)

School of Environment, Natural Science and Geography

Bangor University

Bangor

January 2012

Abstract

Many conservation interventions aim to influence people's behaviour. Success depends upon a proper understanding of what motivates behaviour. I begin by reviewing social psychological models of behaviour, discussing how social psychological predictors of behaviour have been studied within conservation. Many studies focus on general attitudes towards conservation, rather than attitudes towards specific behaviours impacting on conservation success, assuming general attitudes are a useful indicator of behaviour, despite mixed evidence.

Interventions depending upon rules require information about the quantity of people, and the types of people, breaking rules. However, when the subject of investigation is sensitive because it is illegal or socially taboo, it is naive to expect that people will respond honestly to questions about rule breaking when asked directly. Specialised methods exist for investigating sensitive topics yet are rarely used within conservation. I provide evidence that the randomised response technique (RRT) produces more accurate estimates of illicit behaviours compared to conventional surveys. Further, I show that RRT can be adapted to investigate how non-sensitive social psychological characteristics of respondents, such as their attitudes towards specific conservation-related behaviours, can be linked to their behaviour. This paves the way for using RRT to test the effectiveness of innocuous questions as proxy indicators for people's involvement in illicit behaviours.

There has been concern that sanctions for wildlife crimes do not reflect how serious crimes are in terms of illegal profits or the threat status of targeted species. Sanctions should reflect how serious a crime is, whilst being socially acceptable. I use conjoint analysis to understand public and professional opinions as to which aspects of wildlife crimes make them more or less serious, and so deserving of a greater or lesser sentence. Results highlight the gravity judiciaries place on illegal profits when setting sentences. Finally, to understand how sanctions relate to species threat status, I analyse 23 years of wildlife crime sanctioning from the United Kingdom providing evidence that sanction severity increases with threat status and corresponding legal protection.

This thesis is an example of how expanding our knowledge beyond traditional academic boundaries can enhance the development of conservation science.

Dedication

I would like to dedicate this work to Professor Gareth Edwards-Jones who died on 14 August 2011. Had he not provided an open ear when I first decided to apply for a PhD, this work would not exist. He was an inspiration to me, and many other students who preceded me. I miss his wisdom, support, and superb sense of humour.

Acknowledgements

I am hugely grateful to my supervisors Julia P. G. Jones and Gareth Edwards-Jones. Their joint enthusiasm and insight has pushed me to a level of achievement I never dreamt possible.

Much of this thesis depended upon people taking time to complete surveys. I would like to thank all the fishers, farmers, magistrates, conservationists, and members of the public who took time to complete my surveys, and each of the owners and managers at survey locations that allowed me access to their customers. I would also like to thank TRAFFIC and RSPB who allowed me to use the data on wildlife prosecution which have been collected tirelessly by their staff over many years; and Lauren Jones and her family for their assistance in South Africa.

This PhD was funded by a scholarship provided by Bangor University and funds from the School of Environment, Natural Resources and Geography Research Committee. Chapter 3 was supported by funding from the Leverhulme Trust. Chapter 4 was supported by funding from Natural Resources International Foundation. I would like to thank each of these organisations for their support. Thanks are also due to Michelle Jones for her role administering my Research Committee funding, and Alison Evans who has always assisted me when I needed help.

Special thanks go to Paul Cross for creating the best office atmosphere and for always being there to offer words of support, jokes, and encouragement. Aidan Keane also deserves special thanks for being a hugely encouraging, enthusiastic and patient peer whom I have learnt a great deal from. Thanks for all the hugs Sophie!

Thank you to all my friends who have made my time in North Wales so happy, particularly Maria, Duarte and Liz who have been there for me every day!

Dan, thank you, and congratulations for surviving my PhD! Your support has been, and still is worth more than I can say.

Thank you to my family for always being there for me, no matter where in the world my adventures have taken me.

Contents

List of Tables

List of Figures

Chapter 1. Introduction

1.1 Background

Biodiversity loss is largely the result of human activities. Overexploitation, habitat loss, and climate change are all causing species declines, and in some instances extinctions (Schipper et al. 2008; Sodhi et al. 2008). Because human activities are the main driver of biodiversity loss, influencing people's behaviours must form part of the solution. Different approaches attempting to influence conservation-related behaviours have been, and continue to be applied in the field. For example positive incentives offer rewards to individuals or communities for behaving in certain ways; and different livelihood options are promoted to reduce the attractiveness of environmentally harmful behaviours (Milner-Gulland and Rowcliffe 2007). In addition campaigns seek to influence attitudes and public opinion towards environmentally sensitive behaviours making them socially costly (e.g. anti-fur campaigns of the 1980s; Simonson 2001); and enforcement efforts monitor adherence to rules and punish rule breakers to encourage compliance (Keane et al. 2008). No single approach is a panacea for successful conservation, and many conservation interventions combine positive incentives (which reward conservation), negative incentives (which punish environmental damage) and approaches aiming to change attitudes or social acceptability of behaviours (Emerton 1999). However, with conservation funds limited (James et al. 1999), efforts must be made to identify which approaches are theoretically most likely to be effective. This requires that conservationists expand their understanding of what motivates behaviour. To this end, conservationists have much to learn from other disciplines which have developed theories of human decision making.

Successfully influencing human behaviour depends upon a proper understanding of what motivates the specific behaviour of interest (Vlek and Steg 2007). Bioeconomic models, grounded in rational choice theory, have proved useful for investigating how individuals may change their behaviour in response to changing circumstances, such as fluctuations in the market price of bushmeat or agricultural produce, in ways which may not have been foreseen (Damania et al. 2005). However, social psychological models of human behaviour have not been as widely applied in resource management. That is not to say that social psychological characteristics have not received attention. Indeed there is a wealth of knowledge concerning the importance of social norms (including taboos) governed by informal institutions in influencing resource use behaviour of groups and individuals (Agrawal and Gibson 1999; Colding and Folke 2001; Jones et al. 2008a; Ostrom 2000). Attitude has also received considerable attention with studies frequently measuring attitudes towards

wildlife conservation, assuming attitude to be a useful proxy for pro-conservation behaviours (Holmes 2003). However, evidence from conservation and resource management studies suggest that attitude alone is a poor indicator of behaviour (Infield and Namara 2001; Waylen et al. 2009) suggesting there is potential to improve research in this area.

Approaches to conservation which depend upon rules to restrict certain activities such as poaching (Jachmann 2008) or logging (Jepson et al. 2001) require information on levels of rules breaking, and characteristics of rule breakers in order to design and target interventions aimed at improving compliance (Gavin et al. 2010). Remote sensing is a powerful technique for assessing the extent of land-use change over large spatial areas and it has been used to assess the level and extent of illegal deforestation in many countries (Kuemmerle et al. 2007; Laurance et al. 2001). However, it is not possible to detect all types of human disturbances with such technology, for example the harvesting of non-timber forest products or defaunation of forests could occur undetected (Peres et al. 2006). Other indirect methods for assessing illegal resource use including surveys of snares, bushmeat at markets, and transects recording timber removal from forests have been discussed by Gavin et al. (2010). Whilst each of these methods reveals information about the extent of illegal activities, they tell us little about the characteristics, or quantity of people breaking rules. This has management implications; in the absence of direct knowledge of rule breakers, managers have a limited ability to design or target interventions to change behaviour. Unfortunately, questioning people directly about sensitive topics such as rule breaking is problematic as providing honest information may hold undesirable consequences for some (Lee 1993). Specialised methods for asking people directly about their involvement in sensitive behaviours have been developed (e.g. Warner 1965; Miller 1985), but rarely have they been used to assess rule breaking in conservation. Research in this area could benefit from studies which compare estimates obtained across multiple methods, and unique applications of methods specifically developed for investigating sensitive topics (Gavin et al. 2010).

The failure of the death penalty to control poaching of elephant ivory and rhino horns in some African states illustrates how the stiffest penalty possible, alone, is not an effective deterrent (Leader-Williams and Milner-Gulland 1993). Law enforcement has two main components: efforts aimed at detecting illegal activities, and systems for punishing detected criminals; both components are required for successful natural resource management (Keane et al. 2008). For example, rules alone do not change behaviour; under conditions of limited enforcement commercial hunters in the

Democratic Republic of Congo did not alter their prey-selection choices in order to avoid taking legally protected species (Rowcliffe et al. 2004); and poaching from the Serengeti National Park, Tanzania increased during a period of low enforcement, but declined in response to increased enforcement effort (Hilborn et al. 2006). Sanctions awarded for criminal acts should punish offenders, conveying the degree of public disapproval, and create deterrence (Von Hirsch and Roberts 2004). However, wildlife crime in general is under researched (Wilson-Wilde 2010); there is limited empirical analysis regarding sanctions awarded for wildlife crimes, and concern among conservationists that sanctions fail to reflect conservation impact, and may be insufficient to create deterrence (Chaber et al. 2010; Eagle and Betters 1998; House of Commons 2004). In order to understand the sanctioning of wildlife crimes conservationists must understand the various characteristics of defendants which judiciaries consider when setting sentences (Sentencing Guidelines Council 2008); and understand how courts assess how serious a crime was, particularly as judicial assessments of wildlife crime seriousness are likely to differ from that of conservationists.

1.2 Aims and objectives

This thesis is presented in two parts. In **Part One** I aim to increase the understanding of social psychological influences on human decision making and how they have been investigated in the context of conservation and natural resource management. In addition I aim to investigate novel methods for assessing people's involvement in wildlife crimes, and to test the potential of non-sensitive social psychological indicators at predicting peoples' rule breaking behaviour. In **Part Two** I aim to investigate opinions towards the sanctioning of wildlife crimes, and how awarded sanctions relate to the conservation impact of offences. I address a number of gaps in the literature concerning: the way in which indicators of behaviour are studied in conservation; the evaluation of novel methods for assessing rule breaking; linking attitude (and other indicators) to actual behaviour; and the application of sanctions to wildlife crimes.

My specific objectives are:

- To explore the use of social psychological indicators of behaviour in conservation;
- To evaluate the strengths and limitations of novel methods for directly investigating sensitive behaviours in conservation;

- To evaluate the effectiveness of non-sensitive characteristics, such as attitude, at predicting people's involvement in sensitive behaviours;
- To evaluate what makes a wildlife crime serious in the eyes of the public, the courts, and conservationists; and
- To investigate sanctioning of wildlife crimes in an established judicial system.

1.3 Thesis structure

In addition to this introduction, **Part 1** of this thesis presents three chapters. In **Chapter 2** I examine social psychology theories of human decision making and review how social psychological predictors of behaviour have been used in the context of conservation and natural resource management. In **Chapter 3** I discuss some of the difficulties associated with directly investigating illegal or otherwise sensitive topics by gathering data directly from groups of people, some of whom may be rule breakers. Using rule breaking among fly fishers in north Wales as a case study I test two methods specifically designed for collecting sensitive data (the randomised response technique (RRT) and the nominative technique), against a conventional self-complete questionnaire. The relative strengths and limitations of each method are discussed. **Chapter 4** expands the application of RRT to resource management problems beyond that of simply estimating the population-level prevalence of rule breaking. In this chapter I test the potential of non-sensitive indicators (including attitudes, and estimates of peer-behaviour) at predicting rule breaking behaviour as reported through RRT using a case study of carnivore killing by farmers in north-eastern provinces of South Africa.

Part 2 presents two data chapters and the Discussion chapter which draws this thesis together. In **Chapter 5** I investigate the opinions of different groups of people towards a policy issue: the sentencing of wildlife trade crimes. Using conjoint analysis, a method used in marketing to understand which characteristics of a product are preferred by consumers, I investigate which characteristics of wildlife trade crimes (threat status and taxa of species involved, illegal profit, previous convictions, and plea) conservation professionals, magistrates and the public consider most important when asked to make sentencing decisions. **Chapter 6** investigates how sanctions awarded for wildlife crimes prosecuted in the United Kingdom over a 23 year period from 1987 to 2010 relate to the protection status of the targeted species. In **Chapter 7** I discuss the results of this thesis, highlighting the major contributions it makes to research in assessing and sentencing illegal

behaviours in conservation. I also discuss the limitations of the work included in the thesis and suggest how research in this area may continue to develop.

Chapter 2. Conservation and human behaviour: lessons from social psychology

Published as: St. John, F.A.V., Edwards-Jones, G., Jones, J.P.G., 2010. Conservation and human behaviour: lessons from social psychology. Wildlife Research 37, 658-667.

2.1 Introduction

Over the past decades biodiversity conservation has received increasing attention: protected area coverage has increased (Chape et al. 2005), and to date 193 nations have signed the United Nation's Convention on Biological Diversity (UNEP 2010). Despite this increased profile, funding shortfalls remain (James et al. 1999) and overexploitation (Rosser and Mainka 2002), habitat loss (Brooks et al. 2002), invasive species (Blackburn et al. 2004; Clavero and García-Berthou 2005) and increasingly climate change (Carpenter et al. 2008; Parmesan 2006) continue to cause species extinctions (Schipper et al. 2008; Sodhi et al. 2008). The ultimate driver of much of the loss in biodiversity is the increasing human population and associated consumption (van Vuuren and Bouwman 2005). While population growth is a critical issue, it is beyond the scope of most conservation projects which are generally concerned with the more proximate drivers of biodiversity loss such as resource use. Conservation projects will often seek to alter human behaviour, for example encouraging the adoption of agri-environment schemes (Hounsome et al. 2006); reducing poaching within protected areas (Jachmann 2008); or limiting resource extraction (Blank and Gavin 2009; Gelcich et al. 2005). However successfully influencing behaviour depends upon the predictors of human behaviour being diagnosed correctly (Vlek and Steg 2007). Conservation scientists therefore need to be interested in the factors which motivate human behaviour. However many of us working within natural resource management and conservation trained as biological scientists (Adams 2007). In understanding the complexities involved in researching, interpreting and influencing human behaviours we therefore have a lot to learn from other disciplines.

A number of disciplines have offered models of the human decision-making process. Institutional analysis offers one way of identifying how the behaviour of a group, or individual, is influenced by rules governed by either formal, or informal institutions (Agrawal and Gibson 1999). Economic models based upon expected utility theory have been applied within natural resource management for many years (Clark 1973; Just and Zilberman 1983; May et al. 1979; Rae 1971). A well known example is the seminal work by Hardin (1968) which, based upon the assumption that humans seek to maximise their utility, explains elegantly why open access resources tend to be overexploited. However, humans are not *Homo economicus* (Persky 1995); purely rational beings weighing up the costs and benefits of each and every decision in an economic framework. Social psychological characteristics of the decision-maker (for example their personal attitudes), and the pressure that they perceive to behave in a

certain way (subjective norms) also influence decision making, particularly when considering broader decisions such as livelihoods and land use (Rounsevell et al. 2003; Willock et al. 1999). Such considerations are the realm of social psychologists. In this paper we review theories of human decision making from social psychology and consider how they have been used in the context of conservation and natural resource management highlighting where they could be particularly useful to conservation in the future.

2.2 Social psychological models used to understand human behaviour

The theory of reasoned action and its extension, the theory of planned behaviour, (Ajzen 1991; Ajzen and Madden 1986; Fishbein and Ajzen 1975) are the models most commonly used by social psychologists interested in understanding human behaviour. Many studies, where the ultimate objective has been to influence behaviour, have used these theories for example: understanding condom use (Albarracín et al. 2001); illicit drug use (Conner and McMillan 1999); and drivers' speeding behaviour (Parker et al. 1996). The assumption underlying such studies is that an understanding of the predictors of behaviour allow interventions that aim to change behaviour to be better designed (Parker 2002). Indeed, a systematic review of cases which have applied interventions designed around the findings of theory of planned behaviour studies reported that two-thirds of the case-studies recorded some behavioural change in the desired direction after the intervention (Hardeman et al. 2002).

Both the theory of reasoned action and the theory of planned behaviour are based around two assumptions 1) that people evaluate the implications of performing a behaviour before deciding to engage, or not engage in it; and 2) that people make quite rational decisions based upon a systematic evaluation of information available to them (be it correct or not) (Ajzen and Fishbein 1980). These assumptions are similar to those made in economic models (Blume and Easley 2008) but social psychological models use quite different predictors of behaviour. Within the theory of reasoned action, both an individual's attitude towards the behaviour and subjective norms influence whether an individual is likely to carry out that behaviour (Figure 2.1). Attitude is a function of beliefs about the behaviour, and an outcome evaluation of performing the behaviour. For example, in a typical survey respondents may be asked to score (e.g. on a six point semantic scale; Ajzen and Fishbein 1980) a 'behavioural belief' statement: 'Poaching a duiker will provide meat for my family'. This score is multiplied by the respondents' score to an 'outcome evaluation'

statement: 'Eating duiker meat is good for my family'. A subjective norm is what we think other people will think of us if we do (or do not do) the behaviour. It is a function of normative beliefs and the motivation to comply with what a significant person (e.g. village elder, father or religious leader) thinks is appropriate behaviour. For example, respondents score a 'normative belief' statement: 'The village elder approves of me poaching duiker'. This score is multiplied by the respondents' score to a 'motivation to comply' statement: 'Behaving how the village elder expects me to, is important to me'.

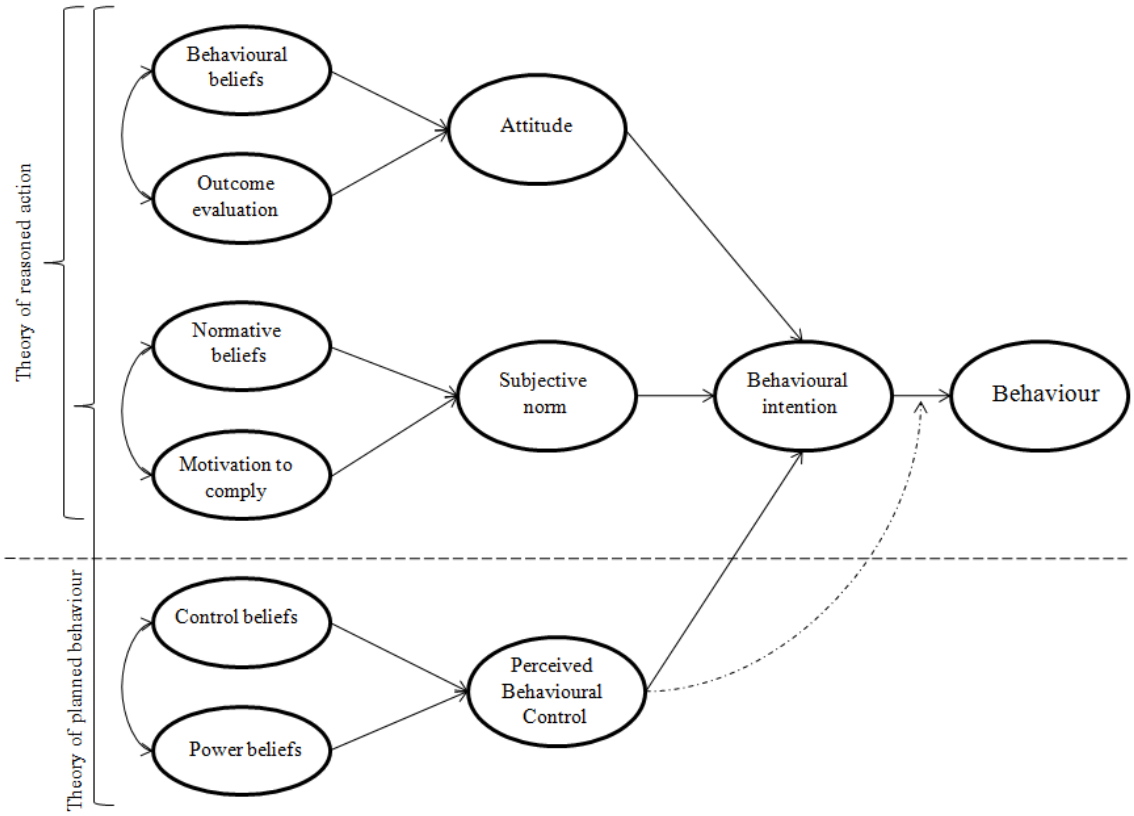


Figure 2.1 The theory of reasoned action and the theory of planned behaviour. All things held equal, the more positive a persons' attitude, subjective norm and perceived behavioural control are, the greater their behavioural intention and thus the likelihood that they perform the behaviour (adapted from Vallerand et al. 1992).

For behaviours which are completely under an individual's control (i.e. depend on conscious personal choice rather than external forces) this theory has been proven to predict behavioural intention (where an individual is asked whether they plan to carry out the behaviour), which has in turn been demonstrated to predict actual behaviour (Ajzen and Fishbein 1980; Albarracín et al. 2001).

The theory of planned behaviour extends this model to include a measure of the perceived control over performance of a behaviour, this is known as perceived behavioural control (Ajzen 2002). Perceived behavioural control is a function of the presence (or absence) of resources (including skills and material items) that facilitate performing the behaviour, and the perceived power that each resource has to facilitate the behaviour. For example respondents score a 'control belief' statement: 'It is easy for me to get wire to make snares for poaching Duiker'. This score is multiplied by the respondents' score to a power belief statement: 'Having access to wire makes it likely that I will poach a duiker'. This extension improves the predictive power of the model for behaviours which are not completely under an individual's control (Ajzen 1991) (Figure 2.1). The theory of planned behaviour is now the most extensively used social psychological model (Hardeman et al. 2002). The relative importance of the three predictors (attitudes, subjective norms and perceived behavioural control) tends to differ from one behaviour to another (Ajzen 1991). By using this model to investigate why people make specific decisions about a behaviour, it is possible to learn which predictor is most important with respect to the behaviour of interest (for example turning a non-tree-planting farmer into a tree-planting farmer; Zubair and Garforth 2006), and therefore which predictor should be the target of behaviour-change interventions.

Some researchers have added other variables to the theory of planned behaviour in an attempt to improve the predictive power of the model. Variables that have improved the theory of planned behaviour include: anticipated regret (Sheeran and Orbell 1999); descriptive norms (how others actually behaviour, rather than what we perceive others will think of us) (Rivis and Sheeran 2003); self-efficacy (Armitage et al. 1999); and moral obligation (Beck and Ajzen 1991; Conner and Armitage 1998). Moral obligation is a person's own perception of the moral correctness or incorrectness of performing a behaviour (Ajzen 1991; Manstead 2000) and so reflects another form of social pressure in addition to subjective norms (Conner and Armitage 1998). Empirical studies which have found moral obligation to be an important predictor of behaviours include studies of reckless driving (Manstead and Parker 1995; Parker et al. 1996), lying (Beck and Ajzen 1991), and cannabis use (Conner and McMillan 1999). Moral obligation was also an important predictor of positive pro-environment behaviours (Bamberg and Möser 2007) including engaging in a recycling scheme (Tonglet et al. 2004) and water conservation (Lam 1999).

2.3 How have models of behaviour been used in the context of conservation?

There are very few examples where these social psychological models have been used within conservation science. The few examples which exist (Aipanjiguly et al. 2003; Beedell and Rehman 2000; Seeland et al. 2002; Zubair and Garforth 2006) have highlighted how information about attitude alone, reveals a limited picture concerning the predictors of pro-conservation behaviours. For example farmers who had already planted trees on their land, and those who had not, both had a positive attitude towards farm forestry suggesting that other factors must influence farmers' decisions to engage in farm forestry (Zubair and Garforth 2006). Subjective norms were important in predicting pro-conservation behaviours including: on-farm forestry (Zubair and Garforth 2006); on-farm conservation behaviours (including hedgerow management and tree planting) (Beedell and Rehman 2000); obeying boating speed limits in manatee (*Trichechus manatus*) areas (Aipanjiguly et al. 2003); and the intention to abide by proposed nature reserve rules (Seeland et al. 2002). As a result of this theory-based research, the authors cited above could specifically identify which person or groups of people (e.g. village elders, family members and friends) play a significant role in influencing whether an individual will engage in pro-conservation behaviours or not. Such information can be exploited for the benefit of conservation allowing interventions aimed at changing behaviour to be better targeted.

Perceived behavioural control was also found to be an important predictor in pro-conservation decision making. For example, Zubair and Garforth (2006) identified factors that inhibited people from engaging in on-farm forestry and were then able to recommend facilitating factors, such as improved communication about markets, establishment of village nurseries, and information about appropriate species, which would increase adoption of this pro-conservation behaviour (Zubair and Garforth 2006).

Whilst social psychological models have received relatively little attention from conservation scientists, some of the predictors of behaviour used in the models have been considered independently in a number of conservation studies.

Attitude studies

'Attitude is the psychological tendency of an individual to evaluate an entity (person, place, behaviour or thing) with a degree of favour or disfavour' (Albarracín et al. 2005). Within conservation there has been a general perception that positive

conservation attitudes, or a positive attitude towards a protected area, are likely to be linked to pro-conservation behaviours, and a number of studies have therefore investigated attitudes towards conservation (see Holmes 2003 for a review). There are very few studies that have put attitudes in the context of other possible influences as suggested by the social psychological theories highlighted above, but some have linked conservation attitudes to socio-demographic variables, or to behaviours which relate to conservation (Table 2.1).

Studies which have explored the relationships between general attitudes towards conservation (or protected areas) and socio-demographic and livelihood variables have done so in order to identify which variables determine positive, as opposed to negative, attitudes (Arjunan et al. 2006; Mehta and Heinen 2001; Nepal and Weber 1995). Investigating local attitudes towards conservation near Kalakad–Mundanthurai Tiger Reserve in India Arjunan et al. (2006) found that women had more positive attitudes towards tiger and forest conservation than men. Further, wealthy residents who stood to lose crops to crop raiding animals, the hunting of which is prohibited, had a more negative attitude towards tiger conservation than poorer residents who did not stand to face such a loss (Arjunan et al. 2006). However, knowing how general attitudes are distributed does not necessarily help in the design of interventions to change a specific behaviour because a person may have a positive attitude to conservation yet still perform behaviours which contradict that attitude (for example poach species which are of conservation concern). A number of studies have collected data on attitudes towards a protected area or species and concluded that respondents hold positive attitudes, yet either do not engage in pro-conservation behaviours, or continue to perform behaviours which have negative consequences to conservation goals. These finding are largely a result of a mismatch in the information collected on attitude and behaviour (see Table 2.1).

Table 2.1 Attitude studies and the use of social psychological frameworks in conservation research

Authors	Attitude towards:	Social psychological framework applied?	Remarks of the authors	Link made between attitude and behaviour?	Authors able to suggest behaviour-specific interventions?[a]
Zubair and Garforth (2006)	Farm-level tree planting, Pakistan.	Yes. Theory of planned behaviour.	'...in addition to attitudes and perceptions farmers also feel social pressure while considering the decision to grow trees on their farms'.	Yes. Relative importance of attitude, subjective norm and perceived behavioural control with respect to on-farm tree planting quantified.	Yes. Programmes promoting farm forestry should seek to intensify indentified favourable attitudes towards tree planting. Village elders influential; thus instrumental in information dissemination.
Aipanjiguly et al. (2003)	Behaviour of boaters in Tampa Bay, Florida.	Yes. Theory of reasoned action.	'...the normative component has a strong influence on the intention to follow [comply with] speed zones'.	Yes. Relative importance of attitude and subjective norms with respect to exceeding speed limits quantified.	Yes. Authors suggest use of normative messages highlighting the opinions of specified 'important others'.
Beedell and Rehman	Farmer's conservation-related	Yes, theory of planned behaviour	'...differences do emerge between the farmers and FWAG farmers [members of the Farming Wildlife Advisory Group] in	Yes. Relative importance of attitude, subjective	Yes. Farmers not implementing conservation

Authors	Attitude towards:	Social psychological framework applied?	Remarks of the authors	Link made between attitude and behaviour?	Authors able to suggest behaviour-specific interventions?[a]
(2000)	behaviours, UK.		terms of the beliefs that they hold. ...FWAG farmers were largely influenced by conservation-related beliefs. ...The farmer group were more influenced by farm management beliefs...'	norm and perceived behavioural control with respect to farmer's conservation-related behaviours quantified.	behaviours unlikely to seek outside help because less influenced by subjective norms.
Seeland et al. (2002)	Restrictions on recreational use of Sihlwald peri-urban Nature Reserve, Switzerland.	Yes, theory of planned behaviour.	'Eighty-eight percent of the variance of behaviour intention was explained by the three determinants attitude, subjective norms, and perceived behavioural control'	Yes. Relative importance of attitude, subjective norm and perceived behavioural control with respect to obeying reserve restrictions quantified.	Yes. Subjective norm most influential predictor of behavioural intention. Recreation clubs to promote collective self-obligation to obey rules.
Arjunan et al. (2006)	Protection of tigers; Kalakad-Mundanthurai Tiger Reserve; and the Forest Department. India.	No.	'Positive attitudes might not necessarily translate into sustainable practices...'.	Yes, but mismatch between attitude (towards tiger conservation) and behaviour (use of forest products).	No.

Authors	Attitude towards:	Social psychological framework applied?	Remarks of the authors	Link made between attitude and behaviour?	Authors able to suggest behaviour-specific interventions?[a]
Mehta and Heinen (2001)	Annapurna and Makalu-Barun Conservation Areas. Nepal.	No.	'The results indicated that the overwhelming majority of respondents held favourable attitudes toward both Annapurna and Makalu-Barun Conservation Areas. ...local people liked the conservation areas mainly because of community development and community forestry programs'.	No. Study investigated socioeconomic and demographic characteristics influencing attitudes. Behaviour within the conservation areas not investigated.	No.
Nepal and Weber (1995)	Wildlife conservation. Royal Chitwan National Park. Nepal.	No.	'...loss of crops and domestic livestock, and threats to human life from wild animals from the park resulted in local people's antagonistic behaviour towards the park and negative attitude towards wildlife conservation'.	Yes, but mismatch between attitude (towards conservation) and behaviour (trespassing in park).	No.
de Boer and Baquete (1998)	Maputo Elephant Reserve. Mozambique.	No.	'The attitude towards the Reserve was correlated with crop damage experiences; people with crop damage caused by elephants, hippos or bushpigs, were more negative'.	Yes, but mismatch between attitude (reasons for liking Reserve) and behaviours (resource exploitation).	No.
Fiallo and Jacobson (1995)	Machalilla National Park. Ecuador.	No.	'...residents living either within or adjacent to [the park] hold a variety of negative attitudes towards the Park. Positive attitudes tended to increase with	No. Positive and negative attitudes quantified but the link to conservation	No.

Authors	Attitude towards:	Social psychological framework applied?	Remarks of the authors	Link made between attitude and behaviour?	Authors able to suggest behaviour-specific interventions?[a]
			respondents' level of education and knowledge about conservation issues.	related behaviours or compliance was not.	
Infield and Namara (2001)	Lake Mburo National Park; and conservation. Uganda.	No.	'Surveys of attitudes show that communities that benefited from the [community conservation] programme were significantly more positive towards the park and wildlife than communities that did not. ...Their behaviour was not greatly changed, and high levels of poaching and illegal grazing continued'.	Yes, but mismatch between attitude (towards the park and conservation) and behaviour (poaching; illegal grazing).	No.
Waylen et al. (2009)	Attitude towards the environment; turtles; and the Trinidad piping-guan. Trinidad.	No.	'Hunting was seen as the main threat to wildlife but was also a popular pastime, illustrating the potential for mismatch between attitudes and conservation behaviours'.	Yes, but mismatch between attitude (general support for conservation) and behaviour (hunting).	No.

[a]Where authors were unable to recommend behaviour specific interventions it was generally because the attitude statements did not correspond to a specific behaviour, the attitude statements were too general.

Such mismatches (e.g. measuring attitude towards conservation, but linking it to a specific behaviour such as trespassing in a protected area) limit how useful the information can be in informing the design of conservation interventions aimed at changing behaviour. For example knowing that crop raiding by wildlife is the cause of negative attitudes towards a protected area (de Boer and Baquete 1998) is useful, as it may spur a project towards designing ways of deterring crop raiding animals. However, such an intervention may be a waste of conservation investment if peoples' negative attitudes towards the protected area never triggered negative behaviours towards the protected area (for example in the form of retaliation behaviours). Equally, positive attitudes towards a protected area related to perceived benefits and good relationships with protected area staff (Fiallo and Jacobson 1995) may not mean that people abide by the rules of the protected area. If ensuring local people benefit from a protected area improves attitudes but does not increase compliance with protected area rules, increasing benefit flows to local people, while important, may alone not be the appropriate way of tackling illegal resource extraction.

Infield and Namara (2001) found that whilst communities around Lake Mburo National Park in Uganda that had been subject to a seven year long community conservation programme had a more positive attitude towards the park and wildlife than communities that had not been included in the programme, behaviour remained largely unchanged with high levels of poaching and illegal grazing continuing. Infield and Namara (2001) therefore concluded that attitude alone is not an adequate predictor of behaviour. Waylen et al. (2009), in their study of attitudes towards two critically endangered species; the leatherback turtle (*Dermochelys coriacea*) and the Trinidad piping-guan (*Pipile pipile*), also reported that attitudes towards conservation did not necessarily predict behaviour. Hunting remained a popular pastime even among respondents who had a positive attitude towards conservation and recognised that hunting threatened conservation (Waylen et al. 2009). However, in both of these studies there is a mismatch between the attitude and behaviour investigated; for example, Waylen et al. (2009) measured general attitudes towards conservation rather than the specific behaviour they were interested in (hunting).

Investigating general attitudes towards a subject (for example conservation) are likely to be of limited use in identifying the predictors of specific behaviours (for example poaching) (Ajzen 1991). If the aim is to influence poaching behaviour occurring in a park then studies of attitudes need to be clearly focused on attitudes towards poaching behaviour, rather than general attitudes towards conservation, or other related topics. Conner and Sparks (2008) suggest that one should consider the

target, action, context and time scale of a behaviour. For example using the theory of planned behaviour we may wish to understand the beliefs underlying the intention to poach (action) an elephant (target) from within the protected area (context) in the next 12 months (time). Armed only with information on general attitude as currently gathered in much conservation research we are lacking behaviour-specific beliefs and vital information about social pressure, internalised moral beliefs, and the perceived control that people feel they have to engage (or not) in a given behaviour, and the relative importance of each of these predictors on actual behaviour. This missing knowledge limits our ability to target interventions effectively. Critically, in the absence of such knowledge we may threaten locally existing subjective norms which also influence human decision making and behaviour.

Subjective norms: social norms and taboo

Social psychology emphasises that a person's behaviour will be influenced by subjective norms: the perceived expectations of valued others (Fishbein and Ajzen 1975). Social norms is a general term for the shared understanding about what actions are obligatory, acceptable or forbidden (Ostrom 2000) and includes general societal expectations of behaviour (Cialdini and Trost 1998) and standards that develop out of observing how others behave (descriptive norms; Cialdini et al. 1990). Social norms are enforced through informal institutions, not dependent upon government juridical laws (North 1994); for example someone breaking a social norm may suffer shame and social rejection (Posner and Rasmusen 1999). Behaviours which are particularly unacceptable, perhaps invoking not only the displeasure of the community but also of religious entities, may be referred to as a taboo (Freud 1950).

Social norms and taboos help govern traditional systems of natural resource management which exist in many non-industrial societies (Berkes et al. 2000). Traditional natural resource management has been important in many parts of the world for centuries. For example, a system of traditional rules known as *sasi*, has controlled spatial and temporal patterns of fishing and forest product harvesting in Maluku, Indonesia, since the 16th century (Harkes and Novaczek 2002). Sami reindeer herders of Norway, have similarly well-established traditional institutions to control reindeer stocking density on communal lands (Bjørklund 1990). Social norms can contribute considerably to the successful management of common-pool resources such as farmer-managed irrigation schemes (Ostrom et al. 1999), pasture management by nomadic pastoralists (Fernandez-Gimenez 2000); and near-shore fisheries of the tropical Pacific islands (Johannes 1982). For example temporal

grazing norms control where and when herders in Mongolia can graze their stock, and a norm of reciprocity safeguards access between neighbouring herders' pasture in the event of climatic disaster (Fernandez-Gimenez 2000).

More recently social norms have been shown to be important in predicting re-enrolment to a payment for ecosystem services scheme (grain-to-green programme, in China's Wolong Nature Reserve; Chen et al. 2009). In a study which used stated choice methods to investigate the relative importance of social norms and conservation payments, social norms were found to be most important when conservation payments were intermediate, and least important at both the lowest and highest levels of conservation payment, where none or all of the respondents would re-enrol. When offered an intermediate conservation payment, farmers based their decisions on what other local farmers were doing: if others were planting trees, then they would chose to plant trees and *vice versa* (Chen et al. 2009).

In a systematic review of taboos held by traditional societies, Colding and Folke (2001) identified six categories of taboos (which they refer to as resource and habitat taboos) which influence conservation. Taboos which may have developed for reasons unconnected to natural resource management may play an important role in conservation (Colding and Folke 1997). For example, taboos have had a role in protecting a number of threatened species in Madagascar including lemurs of the Indiridae family, thought to embody dead ancestors, and the carnivorous fosa (*Cryptoprocta ferox*), believed to scavenge from the bodies of dead ancestors buried in the forest (Jones et al. 2008a). In both of these cases the taboos have their origin in respect for the ancestors, rather than in attempts to manage natural resources, however they play an important conservation role. Sacred groves are another example where conservation is a happy consequence of taboo, and not the result of an innate desire to conserve biodiversity (Gadgil and Vartak 1976). Initially protected for religious or cultural purposes, sacred groves are now increasingly important to biodiversity conservation and ecosystem services including pollination and seed dispersal (Bodin et al. 2006). Of course other taboos can have a negative conservation impact; for example spotted eagle owls (*Bubo africanus*) (Kideghesho 2008) and the aye-aye (*Daubentonia madagascariensis*) (Simons and Meyers 2001) are associated with negative beliefs in parts of Tanzania and Madagascar respectively which can result in their persecution.

Conservation interventions (for example the establishment of a protected area with associated rules) may erode social norms or taboos and the institutions that enforce

them (Anoliefo et al. 2003; Jones et al. 2008a). For example, Jones et al. (2008a) found that the designation of Ranomafana National Park in Madagascar had resulted in the breakdown of traditional management of pandans (*Pandanus* spp.), a plant used for weaving. Since the resource became the property of the park, the social norm which had prevailed (to be careful not to damage the growing tip when harvesting) became widely disregarded. Newly introduced religions and the drive to modernisation have also contributed to the erosion of locally held social norms which traditionally protected sacred groves and streams in Nigeria and Tanzania (Anoliefo et al. 2003; Kideghesho 2008). Where there is limited capacity for enforcement conservationists must take great care when introducing new rules which may inadvertently result in the breakdown of social norms which provide some positive management (Gelcich et al. 2006; Jones et al. 2008a).

Perceived behavioural control

We do not know of any studies in conservation which have quantified the influence of the presence or absence of facilitating factors on decision making in the way that perceived behavioural control does in the theory of planned behaviour (Ajzen 1991). When social psychologists measure perceived behaviour control they are quantifying to what extent people feel that they have the ability to perform the behaviour being investigated. It measures the perceived presence (or absence) of required skills, resources and other prerequisites required, and how much power people perceive each of these factors to have in making the behaviour easy or hard to do (Ajzen 1991). Such factors are important in decision making because people who believe that they have all the necessary resources, and perceive that the opportunity to perform the behaviour exists (with limited obstacles) are ultimately more likely to engage in the behaviour (Conner and Sparks 2008). Although this terminology has not been used in the conservation literature, studies have looked at factors (e.g. available resources and skill) that influence the success of enterprise interventions such as producing essential oils from wild plants or setting up ecotourism ventures (Salafsky et al. 2001), and factors such as product suitability that can influence uptake of project interventions such as installing a fuel efficient stove (Wallmo and Jacobson 1998).

2.4 Discussion

In the field of conservation and natural resource management we are generally good at getting the biology right; identifying new and threatened species and modelling the limits of ecosystems (Mascia et al. 2003). However, slowing biodiversity loss requires that we understand and influence the decision making processes which

result in behaviours which drive the loss. There has been some excellent work using simple economic models to investigate decisions which impact upon conservation success; for example the decision made by a poacher to engage in poaching, involves weighing up of costs (risk of detection and likely sanctions) and benefits (potential profit) (Mesterton-Gibbons and Milner-Gulland 1998). But there are other influences that we know much less about which are important in decision making. Some work has been done on attitudes towards conservation, and there is a considerable wealth of knowledge concerning social norms that govern natural resource extraction. Yet only a few studies have investigated predictors of behaviour in a coherent holistic way. In particular, rarely has human behaviour that impacts upon the success of conservation interventions been studied using existing social psychological models. These models have been tried and tested in other areas including health, illicit drug abuse, and tax compliance. They have made a significant contribution to understanding the beliefs that underlie peoples' decisions to engage in specific behaviours and this information has been used to design interventions that have been successful in influencing behaviour.

There have been a number of studies in conservation in recent years which considered attitudes towards conservation. However, they have been of limited use in designing conservation interventions aimed at changing behaviour, largely because of the mismatch between the attitude studied, and the behaviour of interest. The trend has been to investigate general attitudes towards conservation, rather than attitudes towards specific, clearly defined behaviours which conservationists are interested in promoting or reducing. Some studies have noted that positive conservation attitudes do not translate to pro-conservation behaviours (Infield and Namara 2001; Waylen et al. 2009). This is supported by the social psychological literature, which emphasises that general attitudes do not successfully predict specific behaviours (Conner and Sparks 2008). By more specifically defining the behaviour of interest in terms of target, action, context and time scale; and collecting quantitative data not only on attitude, but also on subjective norms, the presence of facilitating factors, and moral obligation, the predictors of specific behaviours will be better understood.

Biodiversity loss is in large part the result of human behaviours. Whilst these behaviours (for example over-exploitation, habitat conversion, introducing species and burning of fossil fuels which lead to climate change) continue to be the major drivers of loss – so influencing behaviour must form a major part of the conservation solution. As such, we must expand our knowledge and skills in understanding and influencing human behaviour. So we do not waste valuable time we should refrain

from re-inventing the wheel and ensure that we learn from the wealth of knowledge held by other disciplines.

Chapter 3. Testing novel methods for assessing rule breaking in conservation

Published as: St. John, F.A.V., Edwards-Jones, G., Gibbons, J.M., Jones, J.P.G., 2010. Testing novel methods for assessing rule breaking in conservation. Biological Conservation 143, 1025-1030.

3.1 Introduction

There are many approaches to the conservation of biodiversity and management of natural resources, many of which depend, to varying extent, on rules that restrict human use (Gaveau et al. 2009; Keane et al. 2008). For example: protected areas prohibit certain activities within their boundaries (Jachmann 2008; Struhsaker et al. 2005); many countries have legislation protecting certain species (Lee et al. 2005); and rules govern the harvesting of managed populations (Takahashi 2009). However, the existence of rules alone does not change behaviour (Rowcliffe et al. 2004) as demonstrated by ongoing illegal resource extraction (Berkes et al. 2006; Laurance et al. 2004). Understanding levels of rule breaking is important in developing interventions to improve compliance. Unfortunately, directly studying compliance and its determinants is difficult as rule breakers may be unwilling to reveal themselves or to discuss their motivations freely for fear of punishment (Gavin et al. 2010; Keane et al. 2008). Rule breaking can be considered a sensitive behaviour; where answering questions honestly may have implications for participants (Sieber and Stanley 1988). Disciplines such as psychology, criminology and health have developed methods that address the inherent difficulties of collecting data on sensitive topics. However, these have not been widely applied within the context of conservation and natural resource management where most studies aiming to quantify rule breaking by gathering data directly from the public (which includes potential rule breakers) have used questionnaires delivered through face-to-face interviews (Table 3.1).

Table 3.1 Surveys of illegal natural resource extraction from protected areas using conventional survey methods

Authors	Rule breaking behaviour	Method	Remarks of authors on collection of data on sensitive topics
Plumtre et al. (1997)	Hunting inside a national park and sale of illegal bushmeat.	Face-to-face household questionnaires.	"Although there is a perceived drop in frequency [of buying bushmeat] after the war, this may be because people did not want to admit to buying meat at present." "Not everyone asked was prepared to answer certain questions, particularly those about poaching,.."
Loibooki et al. (2002)	Hunting inside a national park.	Face-to-face household questionnaires. Group discussions.	"In contrast to individual respondents, significantly more participants of group discussions said that they were hunters demonstrating that results on sensitive issues such as illegal activities can be influenced by survey method".
Ndibalema and Songorwa (2008)	Consumption and hunting of bushmeat illegally sourced from inside a national park.	Face-to-face questionnaires to villagers. Questionnaires with hunters caught in park.	"Basic questions were easily answered but information related to [illegal] household meat consumption and preferences had to be probed for".
Nepal and Weber (1995)	Illegal resource extraction from inside a national park.	Face-to-face household surveys, group discussions and informal interviews.	"Some respondents would say that they neither trespassed in the Park nor let their livestock graze inside the park grounds; observations and photographic documentation, however, proved otherwise." "Several observations in that area refute the respondents' claim."
Lewis and Phiri (1998)	Illegal snaring inside a game management	Face-to-face interviews with	"The interviews were based on pre-designed questions but were presented in an informal, discursive way to establish greater trust."

Authors	Rule breaking behaviour	Method	Remarks of authors on collection of data on sensitive topics
	area.	known snare users.	
Mann (1995)	Illegal fishing inside a game reserve.	Face-to-face questionnaires completed at community meetings.	”Considerable distrust was initially expressed... because of the illegal nature of the netting being carried out.” “...it was estimated that a further 37 fishermen had not attended the meetings for fear of being apprehended...” “...only 23 fishermen agreed to answer the full questionnaire...”...’

Such interviews can be a cost effective method for obtaining robust information on legal and socially acceptable exploitation of wild species (Jones et al. 2008b). However, when such exploitation is illegal, or otherwise sensitive (goes against social norms for example) biases can reduce the validity of data (Fisher 1993; Warner 1965). This problem has been raised by a number of authors studying illegal natural resource extraction from protected areas (Table 3.1). The two main biases which influence surveys of sensitive behaviour are social desirability bias and non-response bias (Fisher 1993; Warner 1965).

Bias in sensitive surveys

Social desirability bias is the systematic error caused by respondents providing dishonest answers in order to project a favourable image of themselves relative to prevailing social norms (Fisher 1993; King and Bruner 2000). Non-response bias results from a non-random and significant proportion of individuals refusing to take part in a survey, either wholly, or partly (Lahaut et al. 2002). Socio-demographic variables can be used to correct for non-response bias if it is acceptable to assume that respondents and non-respondents within the same category are equal with respect to the outcome variable, which is unlikely (Lahaut et al. 2002).

Assurances of confidentiality tend to increase response rate and validity (including reduced social desirability bias) when the topics are sensitive (Singer et al. 1995). When using a self-complete questionnaire anonymity can be guaranteed by not requesting personally identifying information. However specialised methods exist that as well as guaranteeing anonymity, also minimise respondents' feeling of risk associated with revealing sensitive, and potentially incriminating information (Lee 1993). Examples of risk-reducing methods include the randomised response technique (RRT) (Warner 1965), and the nominative technique (Miller 1985; Sudman et al. 1977). Through different mechanisms both increase response rates and reliability in surveys containing sensitive questions (Lee 1993; Miller 1985; Warner 1965). These methods also protect the researcher since no incriminating data can be directly linked to a respondent (Sudman et al. 1977; Warner 1965).

The randomised response technique

By using a randomising device (e.g. dice), RRT inserts an element of chance in the question-answer process which increases respondent privacy (Lensvelt-Mulders et al. 2005b; Warner 1965). There are a number of RRT designs described in the literature, the merits of which are discussed in depth by Lensvelt-Mulders et al. (2005a). 'Forced response' RRT (Lensvelt-Mulders et al. 2005a) is one of the most statistically

efficient RRT designs and is the one used in this study. Respondents are instructed (rather than forced, as the name suggests) to either: answer a sensitive question truthfully or to say YES or say NO (irrespective of the truth), depending on the number they roll on a die (Boruch 1971 in Lensvelt-Mulders et al. 2005a). For example respondents may be told: if the die lands on one, two, three or four please answer the question truthfully; if the die lands on five, simply answer YES; if the die lands on six, simply answer NO. The result of the die is never divulged to the interviewer. By knowing the probability of respondents answering the sensitive question, and the proportion of respondents instructed to say YES, the proportion of the population with the sensitive characteristic (the number of truthful YES responses) can be calculated without any individual identifying themselves (Lensvelt-Mulders et al. 2005a; Lensvelt-Mulders et al. 2005b; Warner 1965).

RRT has been used across a range of sensitive behaviours including benefit fraud (Bockenholt and van der Heijden 2007), academic cheating (Scheers and Dayton 1987), and illegal abortion (Silva and Vieira 2009). In comparative studies RRT has provided higher estimations of sensitive behaviours compared to anonymous self-complete questionnaires (Donovan et al. 2003; Scheers and Dayton 1987), and face-to-face questionnaires (Silva and Vieira 2009) which has been taken as evidence of more honest reporting. In validation studies where true levels of the sensitive behaviour were known, RRT returned higher levels of correct responses than conventional methods (Lensvelt-Mulders et al. 2005b).

The nominative technique

The nominative technique asks respondents to report the number of close friends that they know with certainty have done the sensitive behaviour. By applying a correction (weighting) for duplication (multiple respondents may report the same person), the proportion of people in the population who have done the sensitive behaviour can be estimated (Miller 1985). A question set using the nominative technique was inserted in the 1977, 1979 and 1982 American National Surveys on Drug Abuse. Researchers found that the life time prevalence of heroin use estimated by the nominative technique was higher than corresponding anonymous self-completed questionnaire data (Miller 1985). Advocates of the method suggest that it reduces social-desirability bias, non-response bias, sampling variance and that estimates gained through this technique are statistically stronger since information is gained about more respondents (Sudman and Bradburn 1982).

Despite the number of studies within conservation highlighting the limitations of conventional approaches to asking sensitive questions (Table 3.1), few studies have used specialised risk-reducing methods designed to overcome the inherent difficulties of such surveys. We found only five published studies using RRT (Blank and Gavin 2009; Chaloupka 1985; Schill and Kline 1995; Solomon et al. 2007; Wright 1980), and we have not found any examples of the nominative technique in the natural resource management or conservation field. Few studies formally compare methods for obtaining data on rule breaking (Gavin et al. 2010). In this study we investigate the potential and limitations of methods specifically designed for estimating sensitive behaviours such as rule breaking, compared with a conventional self-complete questionnaire using a case study of fly fishers in north Wales, UK. Although we did not have estimates of the true level of rule breaking, we expected that the specialised risk-reducing methods would produce higher estimates of rule breaking than the self-complete questionnaire and that this effect would be more marked for more sensitive questions.

3.2 Methods

Case study: fly fishing in north Wales, UK

In the UK fly fishing is a popular sport governed by a set of rules designed to sustain fish stocks whilst protecting waterways and their biodiversity. By law fly fishers in the UK are required to hold a valid Environment Agency (EA) rod license. The EA conduct enforcement patrols and failure to comply can result in the confiscation of equipment and a fine of up to £2,500. National byelaws prohibit the killing of brown trout *(Salmo trutta)* outside of the season (22 March and 30 September in Wales), enforcement is the responsibility of the EA and offences are handled in accordance with the Salmon & Freshwater Fisheries Act 1975: Section 19 (4). Other rules are set by the fishery and failure to comply might result in a ban (see Table 3.2). Currently there are no data available to provide estimates of rule breaking for different fly fishing rules.

Table 3.2 Survey questions – compliance section

Code	Question	Sanction	Sensitivity
No rod licence	In the last 12 months did you ever fly fish without an Environment Agency rod license?	Confiscation of equipment and up to £2500 fine.	High
No day permit	In the last 12 months did you ever fly fish without a valid day permit?	Potentially banned from fishery.	Medium
Used live bait	In the last 12 months did you ever fly fish with live bait in a fly only water?	Potentially banned from fishery.	Medium
Exceeded bag limit	In the last 12 months did you ever exceed the bag limit?	Potentially banned from fishery (but opportunity to pay for extra fish retrospectively).	Medium
Caught undersized fish	In the last 12 months did you ever take undersized fish?	Potentially banned from fishery.	Unlikely to occur at research site.
Killed brown trout	In the last 12 months did you ever illegally take brown trout?	Confiscation of equipment and fine at Magistrates discretion.	Unlikely to occur at research site.

Data collection

Each of the three survey instruments (self-complete, RRT and nominative surveys) were initially piloted on colleagues and improved before a formal pilot with 20 fly fisher respondents. No further improvements were necessary so the pilot data from fly fishers (n = 20) were included in the final analysis. Surveys were administered to a total of 209 fishers at two privately managed fisheries on 19 days between May and July 2009 by FAVStJ The two fisheries are 20 miles (33 km) apart and are similarly priced, offering the same facilities and ease of access to fishing areas. The fisheries were selected because a personal contact introduced FAVStJ to the fisheries owners' who approved the study; the owner was never present when interviews were conducted. Fishers encountered more than once were not re-interviewed.

Survey instruments were made up of two parts: a series of questions related to rule breaking and a simple demographic survey (age, gender, area of residence) including information on fishing behaviour (frequency and number of sites visited). Respondents were randomly allocated one of the three survey instruments (self-complete questionnaire, RRT survey, and nominative questionnaire) by selecting a ball from a cloth bag. Question wording was identical for each of the three survey instruments. All questions referred to the last 12 months to minimise recall inaccuracy (Table 3.2). See Appendix 1 for survey protocol and a full copy of the survey.

Self-complete survey

Respondents were asked to circle YES or NO responses to the six compliance questions. Respondents were left alone to complete the survey and were given an envelope to seal the completed questionnaire in before placing it in a padlocked box.

Randomised response technique survey

The RRT survey followed a 'forced response' model whereby respondents were required to answer the sensitive compliance question truthfully if the die landed on one, two, three or four. Respondents were asked to simply say the word YES, without reading the question, if the die landed on five; and to say NO without reading the question if it landed on six. Because the interviewer does not know whether a respondent is saying YES because they have broken the rule or because the die landed on a five, the interviewer does not have any sensitive information from the respondent. The probabilities associated with each response are given in Figure 3.1. Respondents were given a non-transparent plastic beaker containing one die, one example question card, and six compliance question cards each of which displayed the randomising device instructions. All cards were identical in design, only the questions differed. Respondents first had the method explained to them using the example question. Two strategies were adopted to maximise respondents following the RRT instructions: the analogy of following the rules of a game was used; and respondents were encouraged not to read the question if they threw a five or six, but to directly say YES or NO respectively. Questions were short, so the time taken to read and respond was minimal; as such the interviewer was not able to distinguish forced responses from truthful responses by considering the amount of time that respondents took to answer each question. The proportion of rule-breakers in the sample was then estimated using the 'forced response' model (Boruch 1971 in Lensvelt-Mulders et al. (2005a):

$$\pi_A = \frac{\lambda - (1 - P_1)\pi_F}{P_1}$$

where π_A is the proportion of the sample who have broken the rule, λ is the proportion of all responses that are YES, P_1 is the probability of having to answer the sensitive question truthfully and π_F is the probability of the response being YES, conditional on being forced.

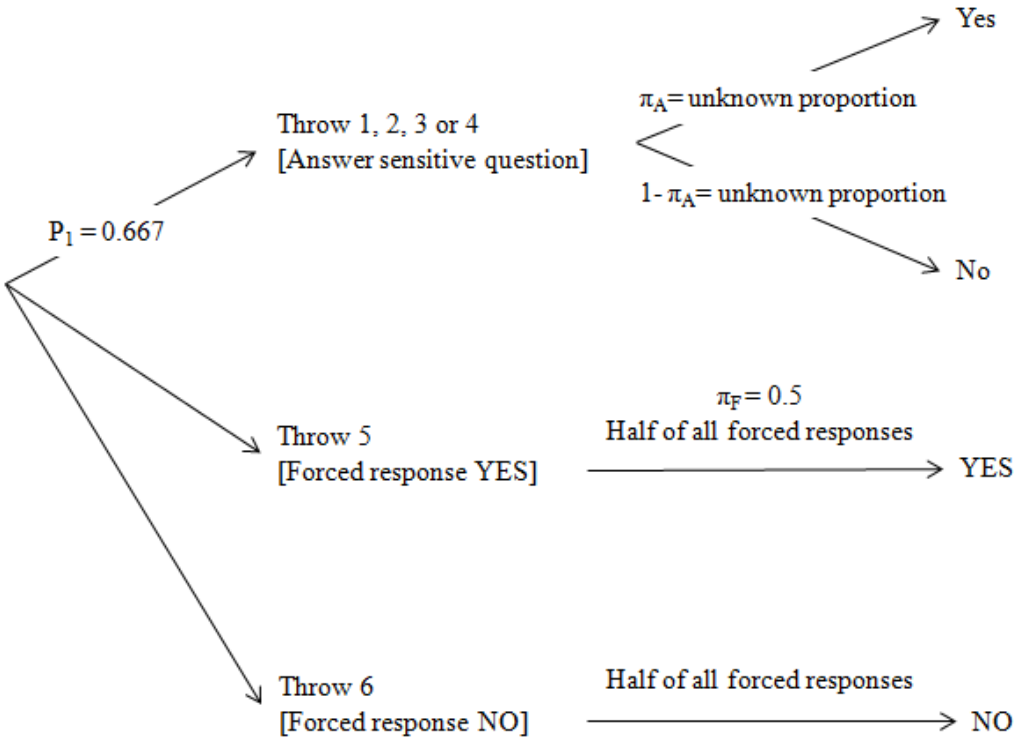


Figure 3.1 Decision tree for a 'forced response' randomised response survey using a single die.

Nominative survey

Each respondent was asked how many of their close friends fly fish. They were then asked if any of these nominated friends break fly fishing rules. If a respondent was aware that any nominated friend had broken a fly fishing rule in the last 12 months the interviewer proceeded to ask the compliance questions in respect of a nominated, but anonymous, close friend. If a respondent knew of more than one rule breaking close friend, they were asked to list the initials of each of them (never revealed to the researcher); one was then selected at random (see Miller (1985) for details).

Respondents were then asked how they were aware that their nominated friend had broken a fly fishing rule; and how many other people were aware of this friend's non-compliant behaviour. Following Miller (1985) this information was used to weight individual responses, eliminating the possibility of multiple-counting of rule breakers:

$$T_X = \sum_{j=1}^{n} \frac{A_j}{1 + B_j}$$

where T_x is the total number of rule breakers in a sample of size n, A_j is the number of rule breakers known to individual j and B_j is the number of individuals (other than j) that know of the nominated friend's rule breaking.

Data analysis

Data were analysed using SPSS PC version 16.0 (SPSS Inc. Chicago USA). Demographic and fishing behaviour data were non-normal and were hence analysed with non-parametric tests for differences between sites and methods. Ninety-five percent confidence intervals of the proportion of rule breakers in each category were estimated from 1000 bootstrap samples for the self-complete, RRT and nominative data. Bootstrap sampling of the RRT data estimates uncertainty arising from the RRT method as well as sample uncertainty. We concluded that there was a significant difference between methods when the bootstrapped 95% confidence intervals for the mean difference did not include zero.

3.3 Results

Just six people refused to participate in the survey (non-response rate <3%). In all cases this was before the method had been selected. Of the 209 respondents 61 answered the self-complete questionnaire, 90 completed the RRT survey, and 58 completed the nominative questionnaire. The mean age of respondents was 54 (± 1.1 Std Error, *n* = 203) and the majority of all respondents (95%, *n* = 199) were male. Respondents fished at the interview location a mean of 30.6 (± 2.4 Std Error, *n* = 179) times per year, and nearly half of all respondents (44%, *n* = 91) did not fish at any other fishery. There was no significant difference between groups randomly assigned to the different methods for age (Kruskal-Wallis test $H = 2.43$, $p = 0.30$, $n = 203$), number of other sites fished at (Kruskal-Wallis test $H = 3.85$, $p = 0.15$, $n = 205$), frequency of fishing at the interview site (Kruskal-Wallis test $H = 0.66$ $p = 0.72$, $n = 179$) or area of residence (local: reside within the same postcode area as the fishery; and non-local) (Kruskal-Wallis test $H = 1.75$, $p = 0.416$, $n = 208$). Most (85%, *n* = 178) surveys were completed at site one. Respondents

interviewed at the two sites did not differ significantly with respect to number of other sites visited (Mann Whitney *U* test 2454.0, $p = 0.40$, $n = 205$) or the frequency of fishing at the interview location (Mann Whitney *U* test 1737.5, $p = 0.60$, $n = 179$).

The proportion of fishers who break each of the six fly fishing rules estimated using the three methods is shown in Figure 3.2. RRT estimated a significantly higher proportion of fishers failing to comply with the legal requirement to possess a rod license (mean difference between RRT and self-complete 0.25), and buy a valid permit (mean difference between RRT and self-complete 0.15). RRT estimated a higher proportion of fishers disregarding bait restrictions than the self-complete questionnaire (mean difference between RRT and self-complete 0.12); these two methods estimated similar proportions of fishers exceeding the bag limit (mean difference 0.02), these results were not significant. The nominative technique produced estimates close to zero for each of the six rules. Estimates of the proportion of the population catching undersized fish and unlawfully killing brown trout were close to zero for all methods.

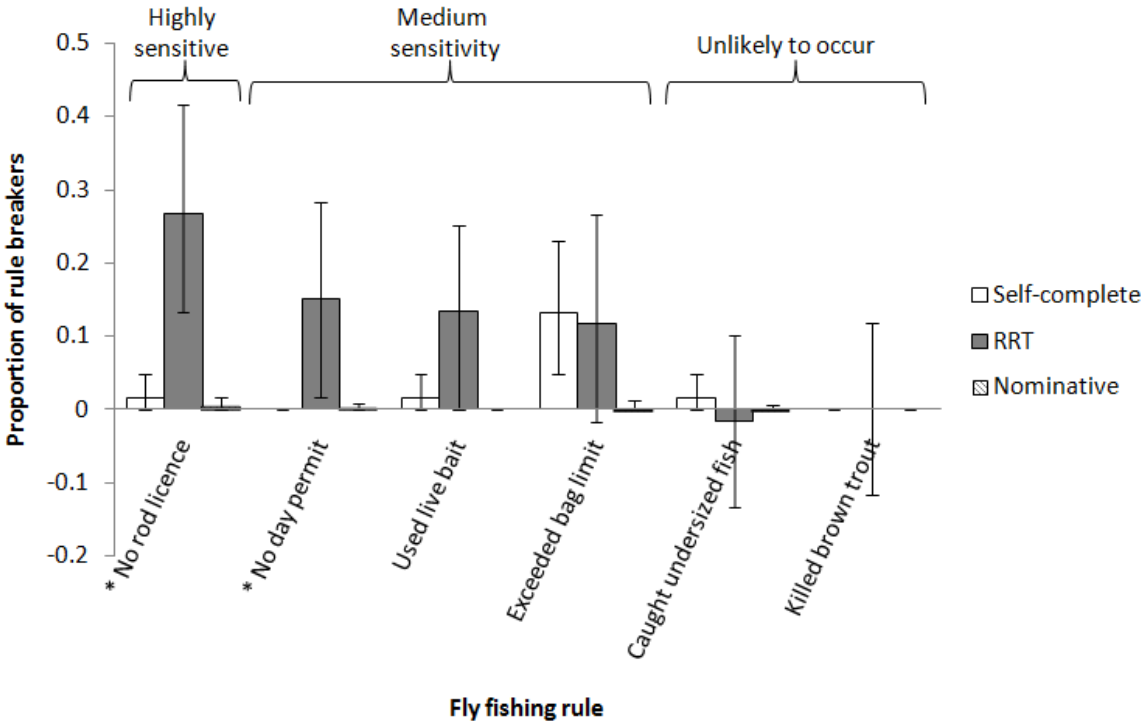


Figure 3.2 The proportion of fishers which break each of the six rules, estimated using the three methods. Error bars show 95% confidence intervals. Negative error bars occur for RRT where by chance the die forced fewer positive responses than expected; a larger sample size would reduce this problem. *RRT results are significantly different compared to the self-complete questionnaire.

3.4 Discussion

Whilst killing brown trout outside of the fishing season and catching undersized fish are against the rules and therefore potentially sensitive behaviours, it became evident whilst collecting the data that the opportunity to break these rules did not exist at the research sites. Ponds are manually stocked with fish that meet the required size limit, and brown trout are limited in number and reportedly difficult to catch (when asked this question most fishers responded with a laugh, stating that they had never caught one). This explains why estimates of these behaviours were close to zero for all methods. For the other four questions, we found large discrepancies between estimates of rule breaking using the three methods. Each method guaranteed anonymity in that no personal information was taken. However, two of the methods (RRT and the nominative technique) were risk-reducing methods specially designed to reduce the level of threat perceived by respondents when asked to reveal sensitive, or potentially incriminating information (Lee 1993). RRT tended to result in higher estimates of rule breaking than the self-complete questionnaire. This effect was particularly marked for the most sensitive question (fishing without a valid rod license), but was also seen for two of the three questions of medium sensitivity (no day permit; used live bait). Higher levels of reporting of sensitive behaviours have been taken as evidence of more honest reporting in other studies (Lensvelt-Mulders et al. 2005b; Scheers and Dayton 1987; Silva and Vieira 2009; Solomon et al. 2007). So we suggest that RRT did appear to be successful in eliciting more honest responses. RRT and the self-complete questionnaire produced very similar estimates for the question on exceeding the bag limit. By admitting to breaking this rule, fishers get the opportunity to boast about their fishing ability which may lessen the perceived sensitivity of the question. In addition, if the bag limit is exceeded, extra fish can be paid for, so breaking this rule is unlikely to result in a ban. RRT results suggest that more than one quarter (27%) of fishers have abused the legal requirement to hold a valid rod license in the last 12 months alone. This represents a considerable financial loss to the Environment Agency. Increasing spot checks may improve compliance but the Environment Agency should be wary of the heavy handed bailiff approach which received negative remarks from fishers. RRT results also suggest the fishery owners are losing considerable income due to fishers failing to purchase a day permit and that many fishers abuse bait restrictions. Whether this loss would justify increased investment in enforcement would need further research.

The nominative technique resulted in estimates of rule breaking close to zero for all six rules. These nominative data are lower even than the level of rule breaking that respondents admitted to via a commonly used method, the self-complete questionnaire. This method depends on respondents being familiar with their friends' behaviour (Miller 1985; Sudman et al. 1977). Perhaps fishers are not adequately informed about the behaviour of their fly fisher friends to provide valid information of their rule breaking. Alternatively, if they are aware of their friends' rule breaking behaviour, they were not prepared to discuss it in a face-to-face interview. This is not in keeping with the findings of Miller (1985) who reported respondents giving up information about their heroine user friends. This method has never been used in a conservation context. It may offer potential in some circumstances but prior to its use, careful consideration will be needed on the likelihood that respondents will have the required level of knowledge about friends' behaviour and the likelihood that people will be willing to disclose such information before deciding to use this method.

Illegal resource extraction has been quantified indirectly in many different ways: transects recording timber removal and snaring within forests (Olupot et al. 2009); satellite imagery of deforestation rates (Steininger et al. 2001); comparison of fish landing statistics with processing plant production (McCluskey and Lewison 2008); survey of snares and bushmeat markets (Noss 1998); and analysis of stock-piled ivory against seizures of illegally traded ivory (Sharp 1997). The merits and limitations of some methods of indirectly measuring illegal resource extraction have been discussed by Gavin et al. (2010). Whilst each of these methods provides an insight into the levels and impacts of illegal resource extraction, they tell us little about the characteristics of rule breakers. This has direct management implications with respect to designing interventions to improve compliance. In the absence of direct knowledge of rule breakers, managers have a limited ability to target interventions to change their behaviour, for example through awareness schemes or through targeted enforcement activities. With limited resources available to manage natural resources worldwide, ways to improve the efficiency of management interventions should be explored. To this end, improving the way in which we gather direct data on rule breaking can play an important role.

There is considerable evidence that face-to-face interviews concerning illegal natural resource extraction provide inaccurate information due to respondents' unwillingness to reveal sensitive information (Table 3.1). Studying rule breaking of fly fishers provided an opportunity to trial two different risk-reducing methods designed for researching sensitive topics: the nominative technique (previously only used to

investigate illegal drug use) and RRT. The nominative technique did not perform well. However, as with other comparative studies (Donovan et al. 2003; Scheers and Dayton 1987; Silva and Vieira 2009; Solomon et al. 2007), we found that RRT returned significantly higher estimates of non-compliance than the conventional questionnaire. This suggests that whilst anonymity may increase reporting, other mechanism can further increase the validity of sensitive data. RRT does have one principal disadvantage compared to conventional methods: the method adds random noise to the data (resultant of the forced YES and NO responses), therefore large samples are needed to obtain estimates with acceptable errors (Lensvelt-Mulders et al. 2005b). However if the topic under investigation is sensitive, this compromise in efficiency is compensated for by the apparent increase in data validity (Lensvelt-Mulders et al. 2005a). Another potential disadvantage is that RRT may be difficult to explain to respondents. However we did not encounter problems during this study and Solomon et al. (2007) have provided evidence of the adaptability of RRT for use in illiterate communities in the developing world.

Too much is now known about the limitations of directly asking people sensitive questions and expecting honest answers for conservationists to blindly use conventional face-to-face interviews to obtain estimates of rule breaking. We suggest that RRT may be a useful, but currently underused, tool for natural resource managers and conservationists.

Chapter 4. Identifying indicators of illegal behaviour: carnivore killing in human-managed landscapes

Published as: St. John, F.A.V., Keane, A.M., Edwards-Jones, G., Jones, L., Yarnell, R.W., Jones, J.P.G., 2011. Identifying indicators of illegal behaviour: carnivore killing in human-managed landscapes. Proceedings of the Royal Society B: Biological Sciences 279, 804-812.

4.1 Introduction

The management of natural resources and conservation of threatened species often rests on the successful management of people's behaviour. For example reducing over fishing, preventing illegal bushmeat hunting, reducing grazing inside protected areas, and encouraging environmentally sensitive farming methods all depend on decisions made by individuals (Edwards-Jones 2006; Hilborn 2007; Infield and Namara 2001; Rowcliffe et al. 2004). Initiatives intended to encourage changes in behaviour (whether through enforcement of existing laws, creating positive incentives, or changing people's attitudes) are most efficient when they target those most likely to be involved in the behaviours of concern. Unfortunately in conservation and natural resource management, many of the behaviours of concern are sensitive because they are illegal or socially taboo, meaning that those involved may not wish to reveal themselves for fear of punishment or social opprobrium (Gavin et al. 2010; Keane et al. 2008). As a result, identifying the key groups to target with interventions aimed at changing behaviour can be challenging and there is a need for indicators which can act as reliable proxies for involvement in these various activities.

A number of studies have looked at people's attitudes towards species, habitats or management interventions, assuming that attitudes are useful indicators of behaviour (Holmes 2003). However the evidence for attitude being a reliable and useful indicator of behaviour is mixed. For example, people involved in a long term community-conservation programme near Mburo National Park in Uganda, had more positive attitudes towards wildlife and the park than people who had not been part of the programme, but little difference in behaviour was observed and high levels of poaching and illegal grazing continued (Infield and Namara 2001). Many such studies have been criticised for failing to ensure that the attitudes investigated were consistent with the behaviours of interest (St. John et al. 2010b). As a result, there is little consensus about whether attitudes can be used as a reliable indicator of behaviour.

A second potential indicator of sensitive behaviour arises from a psychological bias known as the false consensus effect (Petroczi et al. 2008). The term 'false consensus' describes the tendency people have to imagine that others are more like themselves than they really are, causing survey respondents to systematically bias their estimates of population-level prevalence of an activity in accordance with their own behaviour (Ross et al. 1977). For example, people who smoke cigarettes have been found to estimate a higher proportion of smokers in the population, compared with

non-smokers (Sherman et al. 1983). To date, the potential application of the false consensus effect to natural resource management has not been explored.

Other potential indicators of sensitive behaviours include a person's knowledge of rules. This may include laws enforced by formal institutions, and the perceived sensitivity of actions according to prevailing social norms enforced by informal institutions (North 1994). Whilst enforced and punished through different mechanisms, both types of rules aim to deter socially unacceptable behaviours and can attract considerable penalties (Becker 1968; Posner and Rasmusen 1999). The utility of knowledge of formal rules and the perceived sensitivity of behaviours as indicators of sensitive behaviour have not been investigated in conservation and natural resource management.

In order to properly test the effectiveness of any such indicator, it is necessary to be able to link them to an accurate estimate of sensitive behaviour. Recently, innovative survey methods such as the randomised response technique (RRT) (Warner 1965) have been used to make improved estimates of the prevalence of illegal natural resource use (Solomon et al. 2007; St. John et al. 2010a). When the topic of investigation is sensitive, guaranteeing anonymity increases response rate and data validity (Singer et al. 1995); however, RRT provides respondents with an additional assurance of privacy beyond that achieved by ensuring respondent anonymity. This is achieved by using a randomising device (such as dice) to add an element of chance to the question answer process (Lensvelt-Mulders et al. 2005b; Warner 1965). For example respondents may be instructed to role a die (in privacy) and: if it lands on one, two, three, or four to answer the question truthfully, with a 'yes' or 'no'; if the die lands on five to answer 'yes'; and if it lands on six to answer 'no', irrespective of the truth (St. John et al. 2010a). Because respondents never reveal the result of the die to the interviewer, the interviewer is unaware of which responses are truthful and which are forced by the die, ensuring that sensitive behaviours cannot be linked to individual respondents. RRT has been shown to increase the validity of data on sensitive topics (Lensvelt-Mulders et al. 2005a; Lensvelt-Mulders et al. 2005b) in a variety of contexts (e.g., illegal abortion, (Silva and Vieira 2009); and health insurance fraud, (Bockenholt and van der Heijden 2007)) with the extent of gains in data validity increasing with topic sensitivity (Lensvelt-Mulders et al. 2005b). Despite their promise, previous applications of RRT to resource management problems have been limited to assessing population-level prevalence of behaviours and have not linked characteristics of individuals or groups to behaviours of interest.

Human-wildlife conflict is a prominent example of a sensitive issue which is difficult to study directly. Habitat loss and competition for resources in many parts of the world have led many people living in proximity to wildlife to feel that their lives or economic security are at risk (Treves and Karanth 2003). The problems are particularly acute with respect to carnivores which, due to their large home ranges and dietary requirements, are pre-disposed to conflict with humans (Inskip and Zimmermann 2009). Many countries have legislation that legally protects carnivores such as wolves (*Canis lupis*) in the United States of America and India (Agarwala et al. 2010), but killings continue, making protected carnivore persecution an issue of global conservation concern (Treves and Karanth 2003; Woodroffe et al. 2007). Illegal carnivore persecution has been measured indirectly in different ways (Hedmark and Ellegren 2005; Linkie et al. 2003), but such indirect methods tell us little about the characteristics of the people persecuting carnivores making it difficult to target interventions aimed at reducing carnivore killing.

In this study we first use RRT to estimate the proportion of South African farmers in the north-eastern provinces killing five carnivore species and performing two illegal behaviours: failing to hold a valid permit to kill a protected carnivore; and using poison to kill carnivores. Secondly we use logistic regression (van den Hout et al. 2007) to investigate individual indicators of carnivore killing focusing on farmers': attitude towards the existence of carnivores on ranches; estimates of their peers' carnivore killing behaviour; perceived sensitivity of RRT questions; and beliefs about the existence of sanctions. This approach (van den Hout et al. 2007), novel to conservation and natural resource management, allows us to investigate the usefulness of non-sensitive indicators of sensitive behaviours.

4.2 Methods

Case study: carnivore persecution by farmers in north eastern South Africa

South African cattle and game farmers have commercial interest in protecting their stock from carnivores and in this context some carnivores are killed because they are thought to have predated stock (Lindsey et al. 2005). The South African Biodiversity Act of 2004 aims to protect certain species including the near threatened (IUCN 2010) brown hyaena (*Parahyaena brunnea*) and leopard (*Panthera pardus*) but a permit can be obtained to control species covered by this Act (e.g. by shooting or poisoning) if they are causing damage to stock or pose a threat to human life (Department of Environmental Affairs and Tourism 2007). Failure to comply with the Act can attract a fine of up to R100, 000 (~ $15,000) or three times the commercial

value of the specimen concerned, up to five years in prison, or a combination of fine and imprisonment. Other carnivores, such as snakes (except for the Gaboon adder (*Bitis gabonica*) and African rock python (*Python natalensis*)), black-backed jackal (*Canis mesomelas*) and caracal (*Caracal caracal*) are not protected under the Act but they are included in this study to introduce variability into the sensitivity of behaviours under investigation. All five species are widely distributed across the study area (Friedmann et al. 2002) and are known to be killed on ranches as part of pest control activities (Thorn 2009).

Data collection

The survey (Appendix 2) was piloted on colleagues and improved before a formal pilot of 16 farmers from cattle, game and mixed stock farms at game auctions in north-eastern provinces of South Africa. No further improvements were necessary so the pilot data from farmers (n = 16) were included in the final analysis. Surveys were administered to a total of 99 farmers at cattle and game auctions in north-eastern provinces between May and September 2010 by FAVStJ and Lauren Jones. The survey was made up of seven short sections: RRT questions; perceived sensitivity of RRT questions; farmers' estimates of the proportion of peers killing carnivores; basic demographics; beliefs about the existence of sanctions; and two attitude statement sections. RRT questions referred to the last 12 months to minimise recall inaccuracy whilst also allowing an adequate time for the behaviour to have occurred (Table 4.1).

Table 4.1 Randomised response technique questions and information about the sanctions for killing each of the carnivores included in the study

Code	Question	Sanction
Snake	In the last 12 months did you kill any snakes?	None
Jackal	In the last 12 months did you kill any jackals?	None
Brown hyaena	In the last 12 months did you kill any brown hyaenas?	Fine and / or prison[a] in the absence of required permit.
Caracal	In the last 12 months did you kill any caracals?	None
Leopard	In the last 12 months did you kill any leopards?	Fine and / or prison[a] in the absence of required permit.
Poison	In the last 12 months did you use poison to control predators?	Fine and / or prison[b]
Permit	In the last 12 months did you kill any predators without the required permit from the Local Wildlife Authority	Fine and / or prison[a].

[a] Regulation 73 of the South Africa Biodiversity Act 2004 states that: a person is guilty of an offence if they undertake a restricted activity involving a threatened or protected species without a permit. A person convicted of an offence in terms of regulation 73 is liable to (a) a fine of R100,000, or three times the commercial value of the specimen; and / or (b) to imprisonment for a period not exceeding five years; or (c) to both a fine and such imprisonment.

[b] Regulation No. R181 published in Government Gazette No. 24329, of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947) prohibits the use of an agricultural remedy or stock remedy except as indicated on the label. Any persons failing to comply are liable on conviction to an unspecified fine or imprisonment not exceeding two years or to both such fine and imprisonment.

Randomised response technique

A number of RRT designs are described in the literature, we use one of the more statistically efficient designs: the 'forced response' RRT (Lensvelt-Mulders et al. 2005a). Depending upon the dice number they roll, respondents are instructed (not forced as the name suggests) to either: answer a sensitive question truthfully, 'yes' or 'no'; or to give a prescribed response irrespective of the truth (Boruch 1971 in (Lensvelt-Mulders et al. 2005b)). The result of the dice throw is never revealed to the interviewer, so respondents' privacy is fully protected, but by knowing the probability

of respondents being required to answer the sensitive question, and the probability that they were instructed to say 'yes' irrespective of the truth, the aggregate level of the sensitive behaviour can be calculated (Hox and Lensvelt-Mulders 2004; St. John et al. 2010a).

Respondents were required to answer the sensitive question truthfully if the sum of the two dice was five through to ten (probability = 3/4). Respondents were simply asked to give a fixed answer 'yes', if the sum of the two dice was two, three or four (probability = 1/6); and to give a fixed answer 'no' if the sum of the two dice was 11 or 12 (probability = 1/12). The interviewer does not know if the respondent is saying 'yes' because they have undertaken the behaviour, or because the dice summed three or four, (the result of the dice roll is never revealed to the interviewer) so the interviewer does not hold any sensitive information about the respondent. Respondents were given an opaque beaker containing two dice, one example question card, and seven question cards each of which displayed the randomising device instructions. All cards were identical in design, only the questions differed. Respondents first had the method explained to them using the example question. To encourage respondents to follow the RRT instructions the analogy of following the rules of a game was used, and when the dice summed two, three, four, 11 or 12 respondents were encouraged not to read the question but to give their 'forced' response of 'yes' or 'no' directly. For this section only the interviewer recorded answers on behalf of the respondent because they needed both hands to hold the RRT cards and shake dice; all other sections were self-completed by respondents.

Beliefs on the existence of sanctions

To investigate the relationship between reported behaviour (RRT response) and fear of sanctions, respondents were required to indicate the level of penalty they thought applied for killing each species; no penalty, or a penalty of up to Rs.100, 000 and up to five years imprisonment.

Perceived RRT question sensitivity

To understand the perceived sensitivity of each behaviour included in the RRT questions respondents were asked to indicate on a four point Likert scale (Nilsen et al. 2007) (+2 = very uneasy, through to -2 = not at all uneasy. There was no zero in this scale) how they thought most farmers would feel if they were asked to give a direct response to each of the RRT questions.

Attitude statements

To ensure that the attitudes investigated were consistent with the behaviours of interest attitude statements were structured to be target, action, context, and time specific (Conner and Sparks 2008). Using a five point Likert scale respondents were asked to indicate their level of agreement with two attitude statements; we used two variants of an 'attitude towards killing' statement as a check on farmers' response consistency. Attitude towards killing statement (a): 'These days (time) I think that jackals (target) should be killed (action) on ranches (context)'; and statement (b): 'These days I think that killing jackals on ranches is wrong'. Both attitudes statements were completed for each of the five carnivores (ten statements in total). The statements were reverse scored, agreement with 'should be killed on ranches' scored -2 [strongly agree] to +2 [strongly disagree], whilst agreement with 'killing is wrong' scored +2 [strongly agree] to -2 [strongly disagree]; meaning that lower scores corresponded to attitudes that are less favourable to conserving carnivores.

Farmers' estimates of their peers' behaviour

To investigate the relationship of farmers' estimates of the proportion of peers killing carnivores with farmers' reported behaviour, respondents were asked to state how many farmers out of ten (range: zero to ten) in the province, they thought had undertaken each of the seven behaviours presented in the RRT questions in the last 12 months. Following the principles of the false consensus effect, higher estimates should indicate a person's involvement in the sensitive behaviour (Petroczi et al. 2008); however, farmers' responses were re-coded in the subsequent analyses to be consistent with all other variables whereby low scores are indicative of involvement in the sensitive behaviour.

Data analysis

Data were analysed using R version 12.2.0. The proportions of farmers killing each species, using poison, or failing to hold a valid permit (RRT responses) were estimated using the model of Hox and Lensvelt-Mulders (Hox and Lensvelt-Mulders 2004):

$$\pi = \frac{\lambda - \theta}{s}$$

where π is the estimated proportion of the sample who have undertaken the behaviour, λ is the proportion of all responses in the sample that are 'yes', θ is the probability of the answer being a 'forced yes', s is the probability of having to answer

the sensitive question truthfully. Ninety-five per cent confidence intervals for RRT data were estimated from 10,000 bootstrap samples. These confidence intervals therefore incorporate both, uncertainty arising from the RRT method, and sample uncertainty.

To examine the relationship between respondents' reported behaviour concerning each carnivore (their RRT responses) and their attitudes and perceptions, we fitted a generalised linear mixed model (GLMM) with a binary response and binomial error distribution. The grouping structure of the data, whereby each respondent answered questions about several species, was reflected in the model by including individual respondent IDs as a random effect. In this situation, GLMMs are able to make more efficient use of the data than a series of single species GLMs would allow (Gelman and Hill 2007). Species, attitude towards killing the species, attitude towards conserving the species, perceived question sensitivity, beliefs about the existence of sanctions, and estimated prevalence of persecutors were all considered as potential fixed effects within the model.

Prior to modelling, we rescaled the predictor variables so that they were centred on zero and had the same range (from -2 to +2; (Gelman and Hill 2007)). The two forms of attitude data were checked for internal consistency using Cronbach's alpha coefficient (Nilsen et al. 2007; Santos 1999), and correlation coefficients were calculated for each pair of variables using Spearman's correlation. Strongly correlated predictor variables were removed to avoid problems of multicollinearity.

Models with binary responses typically employ a logistic link function. However, simple logistic regression is not appropriate for RRT data because the forced responses introduce bias and additional variability into the data. We therefore wrote a customised link function which incorporated the known probabilities of the forced RRT responses (van den Hout et al. 2007). The resultant model was:

$$\log\left(\frac{\pi - \theta}{\theta + s - \pi}\right) = \alpha_j + \beta_1 x_1 + \cdots + \beta_N x_N,$$

where α_j is the common intercept term for responses given by individual j, β_N is the coefficient for the Nth covariate and x_N is the vector of values for the Nth covariate. This link function behaves similarly to the logit link in logistic regression, constraining the response to lie between lower and upper bounds. With forced responses the

response is bounded at θ and $\theta + s$, but if the probability of forced responses is zero, $\theta = 0$, $\theta + s = 1$ and the link function simplifies to the standard logit link.

The model was fitted by penalised quasi-likelihood (PQL) using the glmmPQL function from the MASS package, which readily accepts user-defined link functions (Venables and Ripley 2002). PQL is a flexible approach which allows approximate inference in GLMMs (Breslow and Clayton 1993), and has been widely applied (Bolker et al. 2009). However, the use of quasi-likelihood precludes standard likelihood-based approaches to model selection, such as Akaike's Information Criterion (AIC) and likelihood ratio tests, and in some circumstances it is known to produce biased estimates (Breslow 2003). To circumvent these limitations, while still benefiting from the power of the GLMM approach, we adopted an ad hoc model selection procedure (see Appendix 3, Section 1 for a discussion of this approach). First, we fitted a series of generalised linear models (GLM) for all possible combinations of predictors for each carnivore separately. The fit of these models was assessed using AIC (Burnham and Anderson 2002) (see Appendix 3, Table 1), and the structures of the best-fitting models were used as a basis for choosing the fixed effects structure for a GLMM incorporating all species. Finally, the parameter estimates from the GLMM were compared with those derived from the separate species' GLMs as a simple check to rule out the presence of large biases (see Appendix 3 Figure 1).

To explore the relative strength of each of the indicators (attitude, sensitivity and farmers' estimates of their peers' behaviour) scenarios were generated from the fitted models. Scenario 1, developed to represent farmers more likely to admit to killing carnivores, had the focal indicator (either: attitude, sensitivity, or farmers' estimates of their peers' behaviour) set at its minimum value while other indicators were set at their average values. Scenario 2, developed to represent farmers less likely to admit to killing carnivores, had the focal indicator set at its maximum value while other indicators were set at their average values.

4.3 Results

For all questions where responses were recorded on a Likert scale, Cronbach's alpha coefficient was above 0.7 showing high internal consistency (Santos 1999). Cronbach's alpha was 0.868 (n = 95) for perceived RRT question sensitivity; 0.795 (n = 98) for the attitude statements in support of killing each species; and 0.882 (n = 97) for attitude statements suggesting killing each species is wrong.

Ninety-nine farmers completed the survey. The majority of farmers interviewed (90.9%, *n* = 90) were male, the mean age was 49 years (Std. Error = 1.0, *n* = 98). Over half of the farmers (55%, *n* = 54) stocked game, or game mixed with cattle or other livestock, whilst the remainder (45%, *n* = 45) stocked cattle or mixed livestock. Most farmers were aware that there was no penalty for killing most snakes (87%, *n* = 83), jackal (85%, *n* = 82) and caracal (59%, *n* = 57), and most were aware that there was a penalty for killing brown hyaena (60%, *n* = 56) and leopard (88%, *n* = 84).

Estimated proportion of farmers killing carnivores and breaking rules

The estimated proportion of farmers that killed each of the species in the last 12 months are shown in Figure 4.1. RRT estimated that a higher proportion of farmers killed non-protected species than protected species. The majority of respondents had killed snakes, and more than 45% had killed the common and widespread jackal, while 22% had killed caracal (the other non-protected species included in the study). Nineteen percent of farmers had killed leopards on their ranches in the last 12 months while only 6% of respondents had killed brown hyaena in the same period (although as confidence intervals overlap zero it is possible that no farmers had killed brown hyaena). The proportions of farmers that used poison to kill carnivores, and killed protected carnivores without a valid permit were similar (21% and 22% respectively).

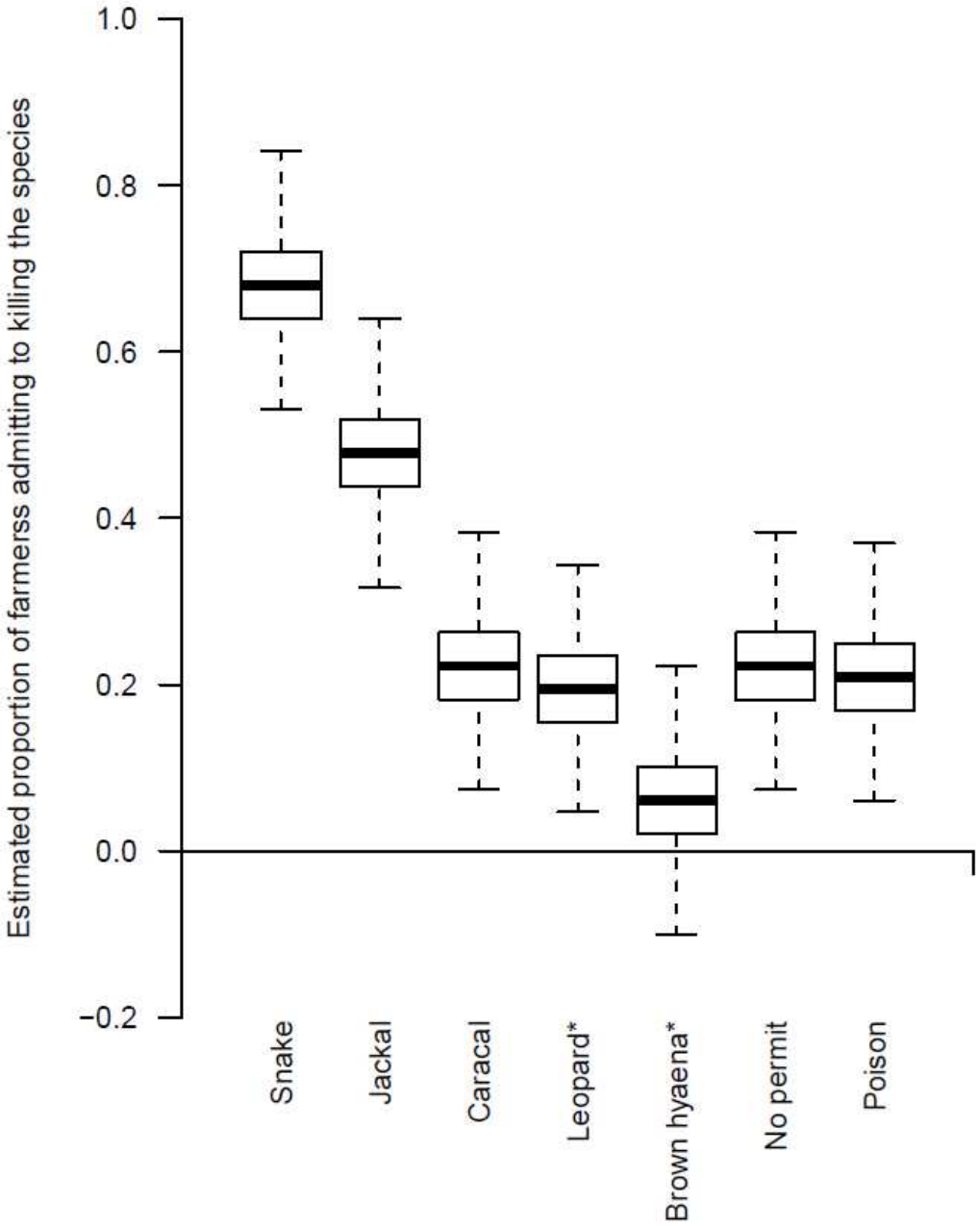


Figure 4.1 RRT estimates of the proportion of farmers that killed each of the five carnivore species or broke permit and poison-use rules in the 12 months preceding the study. Negative estimates can occur for RRT due to the stochastic variability of the forced responses. The bold line represents the median; the lower and upper edges of the box are the first and third quartiles; and the whiskers the maximum and minimum points. *Denote species protected under the Biodiversity Act of 2004.

Indicators of carnivore killing

Owing to the low prevalence of farmers killing brown hyaena we did not carry out modelling for this species. Preliminary examination of the data showed the two

attitude statements to be correlated (Spearman's rank coefficient rs = 0.60, p = <0.001), so to avoid issues of multicollinearity, the variable representing the attitude that 'killing is wrong' was excluded from further analysis; respondents' beliefs about the existence of sanctions correlated with their estimates of peer-behaviour (Spearman's rank coefficient rs = 0.47, p = <0.001) and was also discarded. Visualisation of the remaining predictors suggested that their effects were approximately linear, so for parsimony we modelled them as continuous rather than categorical variables.

The likelihood of admitting to killing any given species was negatively and significantly related to farmers' attitude towards killing species on their ranches (t = -3.326, df = 247, p = 0.001), and question sensitivity (t = -2.063, df = 247, p = 0.04). Farmers estimates of their peers' behaviour was also negatively, but not significantly related (-t = 1.478, df = 247, p = 0.140) to the likelihood of admitting to killing any given species.

Scenarios simulated from the fitted model illustrate the relative strength of each indicator (attitude, question sensitivity, and farmers' estimates of peer-behaviour) at distinguishing differences in whether farmers kill carnivores (Figure 4.2a-c). For example Figure 4.2a illustrates that farmers reporting the attitude that carnivores should be killed on their ranches (Scenario 1) were more likely to have reported killing any given species, compared to farmers reporting that carnivores should not be killed on ranches (Scenario 2). Similarly, farmers estimating that a high proportion of their peers kill carnivores (Figure 4.2c; Scenario 1) were more likely to have reported killing any given species, compared to farmers reporting low estimates of the proportion of their peers killing carnivores (Scenario 2). Results suggest that attitude is the most useful indicator for distinguishing between groups of farmers who are more, or less likely to have killed carnivores; question sensitivity appears only slightly less useful, however in the discussion we explore our concerns about the causes underlying this effect. Although those who believe that many of their peers have killed carnivores are more likely to have killed carnivores themselves, this indicator provides less information for distinguishing carnivore killers from non-killers. Figure 4.2d illustrates the maximum difference in the behaviour of farmers holding attitudes and perceptions at the two extremes: for example, we predict that farmers who estimated that all their peers kill leopards, reported the attitude that leopards should be killed on ranches, and who thought that the RRT question about killing leopards was not at all sensitive (Scenario 1) would have been 69.8% more

likely to have admitted to killing leopards, compared to farmers reporting the polar opposite in responses (Scenario 2).

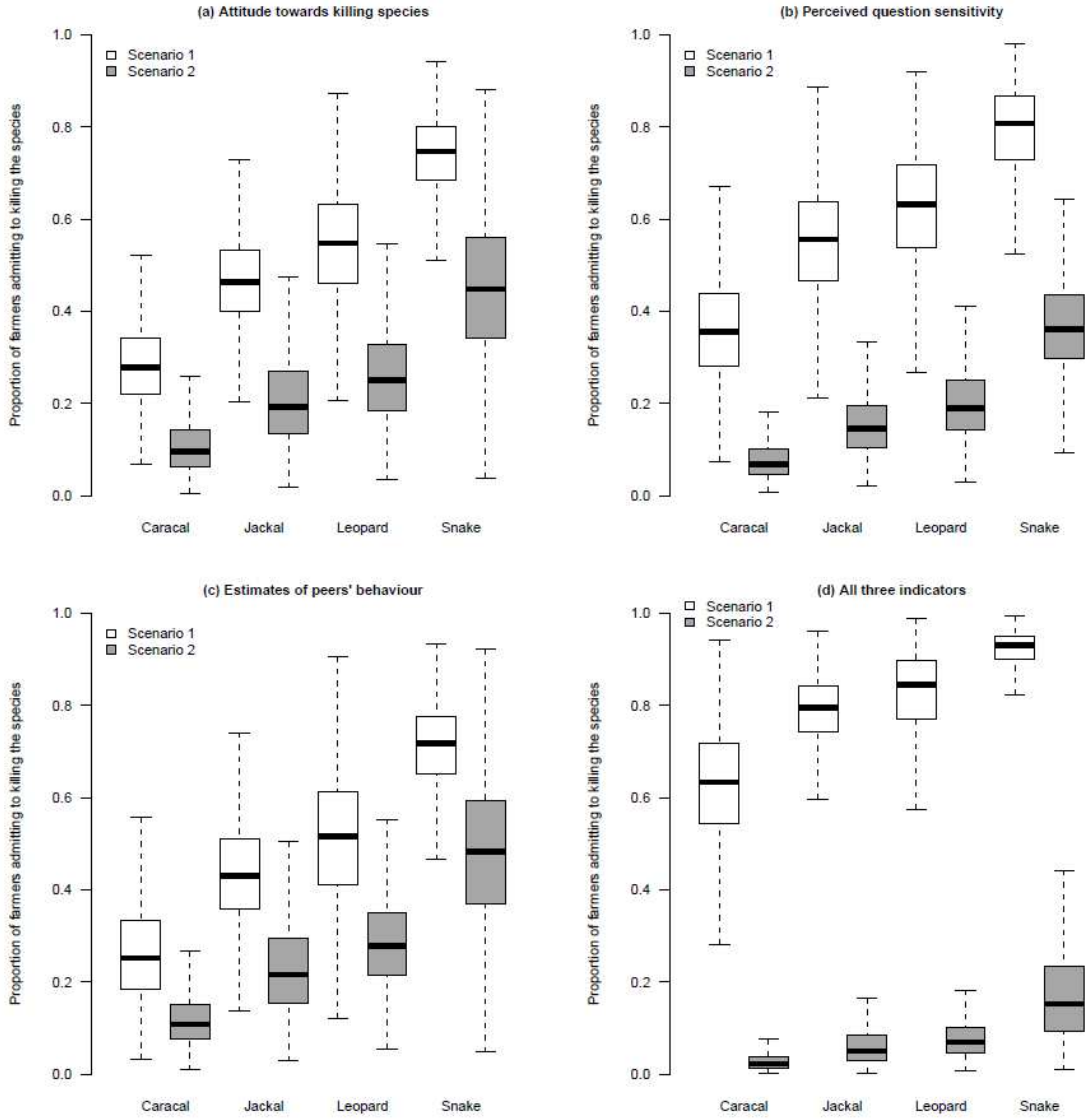


Figure 4.2 Simulations from the fitted model illustrating the relative strength of the three variables, separately (panels a-c) and in combination (panel d), as indicators of the aggregate level of carnivore killing. In panels a-c the focal indicator is set at its minimum (Scenario 1) or maximum (Scenario 2) value, while the other indicators are set to their average values. In panel d, the all three indicators are set at values which indicate the highest (Scenario 1) or lowest (Scenario 2) levels of persecution. Scenario 1 in panel d represents farmers who hold the attitude that the species should be killed on ranches; think the RRT questions are not sensitive; and estimate that a high proportion of peers kill carnivores; Scenario 2 shows the opposite. The bold line represents the median; the lower and upper edges of the box are the first and third quartiles; and the whiskers the maximum and minimum points.

4.4 Discussion

Human behaviours such as illegal hunting (Hilborn et al. 2006), fishing (Mann 1995), wildlife trade (Shepherd and Nijman 2008), or killing due to human-wildlife conflict (Redpath et al. 2004) can be important threats to biodiversity, making understanding and influencing such behaviours an essential part of the solution (St. John et al. 2010b). Many studies have reported that carnivores are killed as a result of conflict with human activities, particularly livestock production where farmers may kill carnivores to minimise actual or perceived losses from depredation (Bagchi and Mishra 2006; Mishra and Fitzherbert 2004; Oli et al. 1994; Zimmermann et al. 2005). Such conflicts are particularly controversial when the carnivores concerned are of conservation concern and / or are legally protected (Graham et al. 2005). Studies investigating such behaviour have used conventional face-to-face surveys to investigate the prevalence of these activities and the attitudes of people towards carnivores, but some have noted conflicting findings (Mishra and Fitzherbert 2004), and suspected underreporting (Oli et al. 1994) because of the sensitive nature of the questions.

In South Africa, where many farmers share land with large carnivores, human-carnivore conflict is of particular conservation concern for the leopard and brown hyaena, (Thorn 2009) both considered near-threatened (IUCN 2010). However, there have been few attempts to estimate the prevalence of killing of these, or other, carnivores. Our estimate that 19% of farmers had killed leopards on their ranches in the last twelve months is worrying given the species' low reproductive rate, cub and sub-adult survival (Nowell and Jackson 1996). We found that a similar percentage of farmers reported killing carnivores without the required permit as had killed leopards, suggesting that farmers rarely hold valid permits when killing protected carnivores. Further, many disregard restrictions which apply to the use of poisons (misused agricultural or stock remedies) for controlling carnivores, suggesting that communication and / or enforcement of wildlife laws is inadequate. We found a very small proportion of farmers (possibly none) killed brown hyaena in the last 12 months. Leopards, whilst less abundant in the study area than brown hyaenas (Thorn 2009), are generalist predators (Nowell and Jackson 1996) whilst brown hyaenas are primarily solitary nocturnal scavengers that supplement their diet with wild fruit, insects and bird eggs (Mills and Hofer 1998). These ecological differences may partly explain the difference in levels of persecution and possibly current densities. Our study confirms suggestions by others that jackals, and to a lesser extent caracals,

are commonly killed within farming areas of South Africa, but remain relatively abundant (Nowell and Jackson 1996; Sillero-Zubiri et al. 2004).

By adapting the logistic regression model to incorporate the known probabilities of forced RRT responses, we were able to investigate individual predictors of carnivore killing in a GLMM framework. In our model we found a negative relationship between question sensitivity and RRT response; farmers who reported an RRT question about a specific carnivore as being sensitive were less likely to admit to killing that carnivore. There are two possible explanations for this. Reports of perceived question sensitivity may have captured farmers' beliefs about the sensitivity of the action with respect to prevailing social norms, so farmers who reported a question as sensitive were genuinely less likely to kill that carnivore. However, some farmers may not have been willing to admit to killing certain carnivores despite the protection offered by RRT. It is impossible to rule out under-reporting of sensitive behaviour even when using such specifically designed techniques (Landsheer et al. 1999; Lensvelt-Mulders and Boeije 2007). However evidence from validation studies where the true status of each individual is known, (e.g. through access to police records) suggest that RRT returned more accurate responses compared to conventional survey instruments (Lensvelt-Mulders et al. 2005b); and, studies comparing survey methods found that RRT returned significantly higher estimates of sensitive or illegal behaviours compared to conventional surveys, which has been interpreted as evidence of more honest reporting (Donovan et al. 2003; Scheers and Dayton 1987; Silva and Vieira 2009; Solomon et al. 2007; St. John et al. 2010a). We also used what is known as a symmetrical RRT design (prescribing fixed responses as both yes (when dice sum two, three, or four), and no (when dice sum 11 or 12), which has been shown to increase the extent to which respondent follow RRT instructions (Ostapczuk et al. 2009). Compared to conventional methods RRT has one principle disadvantage. Due to the random noise (added by the forced responses) RRT requires large samples in order to get estimates with acceptable precision (Lensvelt-Mulders et al. 2005b).

A number of studies have investigated people's attitudes towards carnivores (Bagchi and Mishra 2006; Lindsey et al. 2005; Naughton-Treves et al. 2003; Nilsen et al. 2007; Oli et al. 1994; Zimmermann et al. 2005) but none have formally investigated the relationship of these attitudes with peoples' conservation-related behaviours, e.g. killing of protected species. A farmer's negative attitudes towards a carnivore as a result of stock loses, may be mitigated by offering compensation for losses (Agarwala et al. 2010), but if the negative attitudes never resulted in farmers persecuting protected carnivores then such interventions may be considered a poor conservation

investment, as such it is critical to understand in what instances attitudes relate to behaviour. Incorporating attitude as an indicator of behaviour into our GLMM allowed us to investigate directly whether farmers' attitudes towards the existence of carnivores on their ranches reflect their reported behaviour. Results suggest that farmers who hold the attitude that carnivores are pests and should be killed on ranches are indeed more likely to have killed carnivores in the last 12 months (as estimated by RRT). A number of studies have not found a clear relationship between attitudes and behaviour in the context of conservation (Infield and Namara 2001; Waylen et al. 2009). However such studies tend to investigate general attitudes (such as a person's attitude towards conservation) and then attempt to link this to a very specific behaviour (such as poaching a particular animal from within a protected area); an approach which has been heavily criticised recently (Conner and Sparks 2008; St. John et al. 2010b). By clearly specifying the time-scale, target, action and context of the attitude (these days [time] I think that jackals [target] should be killed [action] on ranches [context]) we found that attitude can be a useful indicator of behaviour.

The relationship between farmers' estimates of the proportion of peers killing carnivores and their own behaviour (as reported through RRT) supports the existence of the false consensus effect (Ross et al. 1977), whereby people who engage in socially undesirable behaviours provide higher estimates of the prevalence of that behaviour in the population, than do people not engaging in the behaviour (Monin and Norton 2003). Our data supports the suggestion by Petroczi et al. (2008) that asking respondents to estimate the proportion of people in the population that they think perform sensitive behaviours, offers some potential in identifying groups of people who perform sensitive behaviours.

Our findings demonstrate the potential value of simple non-sensitive indicators for targeting conservation interventions. However our finding that attitude, and the perceived sensitivity of killing carnivores, predict carnivore killing in our models, also supports other evidence that farmers' decisions to kill carnivores on their land is not purely based purely on economic costs and benefits. For example, Lagendijk and Gusset (2008) found that some people living around the greater Kruger area in South Africa do not kill lions even when they suffer economic losses and no compensation is available, and suggest that this is because of 'cultural tolerance'. In fact evidence suggests that cultural tolerance of species, including carnivores, reduces extinction probabilities (Karanth et al. 2010). Compensation for livestock killed by carnivores may be important to encourage commercial farmers to tolerate carnivores (Lindsey

et al. 2005). However, social marketing campaigns that apply commercial marketing concepts and techniques to promote behaviour change have had considerable success in influencing undesirable behaviours such as cigarette smoking and illicit drug use (Gordon et al. 2006). A social marketing campaign promoting the view already held by many farmers, that killing protected carnivores is generally socially unacceptable, and encouraging national pride and tolerance towards South Africa's protected carnivores may be an effective way of changing farmers' behaviour. Any behaviour-change intervention will take time to affect a change so enforcement of existing laws will continue to be important.

4.5 Conclusions

When the subject of a survey is sensitive, as is the case with illegal carnivore persecution, it is naïve to expect that respondents will provide honest responses when asked questions directly. The randomised response technique allows researchers to gain more accurate estimates of sensitive behaviours and we have shown that it can be adapted in order to identify indicators of behaviour. Reducing carnivore killing could be critical to the persistence of charismatic and declining carnivores such as leopard and brown hyena in human-managed landscapes. Our results provide evidence that carefully specified attitude statements and people's estimates of the prevalence of sensitive behaviours among their peers may be useful indicators of an individual's involvement in illicit behaviours. Such information can be used to identify groups of people to involve in interventions aimed at changing behaviour.

Chapter 5. Opinions of the public, conservationists, and magistrates on sentencing wildlife trade crimes in the UK

In press: St. John, F.A.V., Edwards-Jones, G., Jones, J.P.G. Opinions of the public, conservationists, and magistrates on sentencing wildlife trade crimes in the UK. Environmental Conservation.

5.1 Introduction

Overexploitation of wildlife is one of the principal causes of biodiversity loss (Stuart et al. 2004; Bradshaw et al. 2009), and targeted exploitation for international trade represents a significant threat (Blundell and Mascia 2005). Globally hundreds of millions of plant and animal specimens are traded as traditional medicines, bushmeat, ornamental plants, timber, and luxury items such as caviar and furs. The legal trade is worth billions of dollars per year (CITES [Convention on International Trade in Endangered Species of Wild Fauna and Flora] 2011) but in addition, there is a very substantial illegal trade (Cook et al. 2002). Criminal sentencing has multiple purposes, including the punishment and reform of criminals, protection of the public, and the reduction of crime through incarceration and by generating deterrence (Keane et al. 2008; Roberts et al. 2009). There has been concern that sanctions for wildlife trade crimes do not reflect how serious such crimes are in terms of the potential illegal profit (House of Commons 2004; Chaber et al. 2010; Johnson 2010), the threat status of the species involved, or the level of loss to society (Eagle and Betters 1998). However, whilst setting penalties as high as possible may be theoretically optimum in some circumstances (Becker 1968) sanctions can be counterproductive if they are considered unfair (van Vugt 2009). As such, in addition to reflecting how serious a crime is, sanctions should be socially acceptable, for this reason public and professional opinions of crimes are often consulted (Roberts et al. 2009; Sentencing Council 2011). Understanding rule breaking is important for developing interventions to improve compliance (St John et al. 2010), however wildlife crime in general is under researched (Wilson-Wilde 2010) and little is known about how members of judiciaries involved in sanctioning wildlife trade crimes, conservationists, or the general public, view offences.

CITES is an international agreement between governments which aims to ensure that the international trade in wild plants and animals does not threaten their survival. Once a country has ratified the Convention, legislation is required to implement it; for example, in the UK, CITES is implemented through both European and domestic legislation. Despite the long history of CITES, the fact that it has been signed by 175 countries, and that numerous domestic and regional laws have been developed to enact it, illegal wildlife trade continues. For example a recent study estimated that five tonnes of bushmeat, 39% of which were CITES-listed species, were smuggled in personal luggage per week through Charles de Gaulle airport in Paris, France (Chaber et al. 2010). Further, some of the largest exporters and importers of wildlife products, such as Brazil and the USA, are not fully compliant with CITES

requirements (Phelps et al. 2010). Eagle and Betters (1998) raised concern that fines awarded for infractions of CITES in the USA do not vary appropriately with respect to species' threat status; similarly, sanctions in Europe and Australia tend not to reflect the conservation impact of, or the profits gained by wildlife trade criminals (House of Commons 2004; Chaber et al. 2010; Johnson 2010). By applying sanctions that inadequately take account of the ecological impacts of wildlife crimes and the potential profits to be made from such crimes, judiciaries are failing to reimburse society for losses and to deter future crimes (Eagle and Betters 1998).

Within England and Wales, magistrates' courts deal with 97% of all criminal cases (Raine and Dunstan 2009). An important guiding principal of sentencing is that the sanction should fit the crime. Magistrates initially consider how serious the crime was; this can be straightforward if the crime can be assessed in purely economic terms (for example by the amount of illegal profit made). However for crimes where this is not possible, assessing crime seriousness can be difficult, involving a measure of culpability and harm, both of which can be subjective (Raine and Dunstan 2009). Magistrates then consider any mitigating or aggravating factors, such as previous crimes by the defendant and the defendant's plea. Further, in order to equalize the impact of sanctions on criminals with different circumstances, magistrates are required to take into account the financial circumstances of the criminal (Sentencing Guidelines Council 2008). In summary, magistrates consider two key factors when deciding upon a sentence: (1) crime seriousness, which may include the amount of illegal profit made and harm done; and (2) any mitigating or aggravating factors, such as the criminal's plea and previous convictions. To reduce disparity in sentencing, guidance is available for different types of crimes (Sentencing Guidelines Council 2008). However, the Magistrates' Court Sentencing Guidelines do not include guidance on sentencing wildlife trade crimes. The Magistrates' Association has produced a guide focused on environmental crimes to help magistrates in the sentencing of such offences (Magistrates' Association 2009). However, with few wildlife trade crimes reaching court, magistrates have limited experience in processing such crimes and are unlikely to be familiar with the example prosecutions presented (Magistrate, personal communication 2011). Further, defining seriousness is particularly challenging, as wildlife trade crimes can be thought of as victimless or costless rather than as thefts of public resources motivated by profit (Wilson-Wilde 2010); cases presented to magistrates often fail to provide adequate information about the threat status of species involved (harm caused) or the potential profits to be made (House of Commons 2004).

In this study, we use conjoint analysis, a method used in marketing to investigate the attributes of a product valued by a consumer (Green and Rao 1971), to investigate which attributes of wildlife trade offences UK-based conservation professionals, magistrates and the general public consider most important when sentencing wildlife trade criminals. The principal underlying conjoint analysis is that purchasers evaluate the overall desirability of a product using the value of the products' separate parts or attributes. For example, a purchaser's preference for a house may depend upon the conjoined influences of attributes such as distance from work, number of rooms or size of garden. By systematically varying these attributes and observing the choices made by purchasers, the value of the separate attributes can be statistically deduced (Orme 2006). Conjoint analysis has been used in many non-marketing contexts, including: animal disease (Cross et al. 2009); health care (Ryan and Farrar 2000); environmental planning (Álvarez-Farizo and Hanley 2002); willingness to pay for conservation (Hanley et al. 2003); and criminal sentencing (Brocke et al. 2004). We developed hypothetical wildlife trade crime profiles that varied in respect of attributes presumed to influence the severity of wildlife trade crimes in terms of both offence seriousness (taxon, trade protection owing to threat status as given by European Union [EU] Annexes and illegal profit) and mitigating or aggravating circumstances (previous convictions and plea).

5.2 Methods

Survey instrument

The survey was made up of three parts: a brief information section which included photos of wildlife known to be traded including whole animals, by-products and eggs; 15 conjoint tasks; and a demographic section (for complete survey see Appendix 4). Attributes of wildlife trade crimes investigated were: taxon, trade protection, illegal profit, previous convictions and a defendant's plea (Table 1). Full-profile conjoint analysis tasks, designed using Sawtooth Software SSI Web 7 (Sawtooth Software Inc. 2010), were presented to respondents. For each conjoint task they were required to indicate on a five-point scale which of the two offences they would award the higher sentence to, or if they would award the same sentence to both offences (Figure 5.1).

Table 5.1 Attributes and levels included in the conjoint analysis tasks

Attribute	Attribute levels	Rationale
Taxon	Birds Fish Reptiles Mammals Including whole animals, their by-products, or eggs.	Items from each of these categories are traded illegally. It is unknown if species charisma influences opinion of crime seriousness.
Trade protection	(I) Trade allowed only in exceptional circumstances. EU Annex A: Species face extremely high risk of extinction in the wild. International trade is prohibited except when it is non-commercial when an export permit and import permit must be granted and a re-export permit is required if the specimen is re-exported. (II) Trade allowed, permits always required. EU Annex B: Species may become threatened with extinction unless international trade is controlled. International trade is permitted but requires an export permit. A re-export permit is required if the specimen is to be re-exported outside of the EU. (III) Trade allowed, permits occasionally required. EU Annex C: Species are mostly widespread and abundant but trade is regulated in some EU States. International trade is permitted but a certificate of origin is required when importing into the EU. Export or re-export permits are required when exporting outside of the EU.	In the UK the legal trade in wildlife products is permitted under the EU Wildlife Trade Regulation (EC) No. 338/97 which groups species into four Annexes A – D according to the degree of protection required. This study uses the EU Annexes to convey the conservation impact of the crime committed. To simplify the EU Annexes for respondents they were informed that animals are afforded one of three levels of trade protection: (I) trade allowed only in exceptional circumstances; (II) trade allowed, permits always required; (III) trade allowed, permits occasionally required. The Magistrates' Association (2009) suggests that the

Attribute	Attribute levels	Rationale
		potential impact on biodiversity of a wildlife crime should be taken into account.
Illegal profit	£500 £10,000 £100,000	The level of illegal economic gain is considered by magistrates (Sentencing Guidelines Council 2008).
Similar previous convictions	Previous convictions No previous convictions	Previous convictions, and a defendant's plea are considered by magistrates (Sentencing Guidelines Council 2008)
Defendant's plea	Not guilty Guilty	

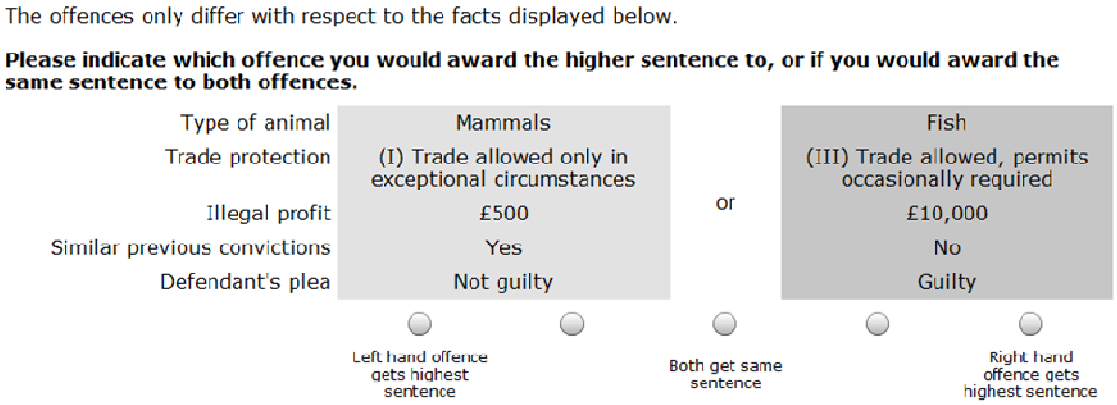


Figure 5.1 An example of a conjoint analysis task. Respondents are required to indicate which of the two offences they would award the higher sentence to, or if they would award equal sentences to both.

The five attributes and 14 attribute levels were combined to construct a 4 × 3 × 3 × 2 × 2 factoral design measuring main-effects, based on the attributes and attribute levels (Table 1). Conjoint task design allowed for attributes and levels to be independent of each other to ensure efficient estimation of utilities. However, because the number of conjoint tasks presented to respondents was limited to avoid respondent fatigue, the design was not entirely orthogonal (i.e. the design did not achieve zero correlation between attributes). Whilst the software produces high

quality designs, it is unlikely to be orthogonal or completely balanced if design constraints are applied, such as asking fewer than the optimal number of conjoint tasks. This study has ten parameters to be estimated (calculated as: total number of levels – number of attributes + 1). It is recommended that respondents complete three times the number of conjoint tasks as there are parameters in the study; or a minimum of 1.5 × the number of parameters in the study (Sawtooth Software Inc. 2010). According to these guidelines, the optimal range of conjoint tasks in this study was between 15 and 30. Since 30 conjoint tasks are too many for respondents to continue to provide high quality responses, the minimum of 15 was assessed. Reducing the number of conjoint tasks had minimal impact on the design efficiency, decreasing it to 0.97 (where 1.0 indicates an orthogonal design) (Sawtooth Software Inc. 1997). To reduce psychological effects such as question order and context bias (Schwarz and Sudman 1992), three versions of the survey were generated; each version presented a unique set of conjoint tasks. These were distributed randomly to respondents in approximately equal quantities.

Data collection

The survey was piloted on colleagues and improved before a formal pilot with 31 members of the general public. No further changes were required, so the pilot data (n = 31) were included in the final analysis of data from the general public. Identical online surveys were created for completion by conservation professionals and magistrates.

Data collection – conservation professionals

A sampling frame was developed from the online list of organizations involved in the UK Biodiversity Action Plan (JNCC [Joint Nature Conservation Committee] 2010). Hobby groups, companies whose primary function was not conservation or natural resource management, and socioeconomic enterprise projects were excluded from the sampling frame, leaving 321 organizations. Between 21 and 26 October 2010, 195 organizations received a survey invite by e-mail (from Freya St John), which included an http link to start the online survey. Survey invites were staggered over a number of days to avoid the survey running slowly in the event that many people attempted to access it at any one time. All invitees were informed that they might forward the survey link to colleagues and friends working for conservation organizations. Where personal contacts of the authors existed within an organization included in the sampling frame, they were contacted individually. The maximum sample size (limited by the academic license for Sawtooth) of 250 was reached prior

to all 321 organizations on the sampling frame being contacted. The online survey closed on 17 November 2010.

Data collection – magistrates (Justices of the Peace)

Four Clerks to the Justices in Wales agreed to send out the survey invitation. Between October and November 2010, magistrates presiding in Welsh courts received an email survey invitation (composed by Freya St John) from the personal assistant of their Clerk to the Justices. The survey invite included an http link which started the survey. The online survey closed on 17 January 2011, by which time 182 magistrates (9.8% of magistrates presiding in Welsh courts; trained identically to those in England) had completed the survey.

Data collection – general public

Following the approach taken by Nilsen *et al.* (2007) for sampling the general public, we approached potential respondents (aged 18 to 65 years) in public places such as cafés and trains in rural and urban locations in England and Wales. We varied survey location, and specifically targeted under-sampled groups to achieve a sample close to the UK population in terms of gender, age and income (based on the 2001 National Census; Office for National Statistics 2008). Between September 2010 and April 2011, 250 people completed the survey. As we did not apply strict probability sampling (Newing 2011), the sample is unlikely to perfectly represent the UK general population and so results should be interpreted with a degree of caution in this respect.

Data analysis

The relative preference for attributes and attribute levels presented in the hypothetical wildlife trade crime scenarios were calculated for each of the three groups using hierarchical Bayes estimation in SSI Web 7 (Sawtooth Software Inc. 2010). This analysis estimates a hierarchical random coefficients model using a Monte Carlo Markov Chain algorithm. At the upper level, this hierarchical model considers respondents as members of a population of similar individuals whose part-worth estimations are assumed to have multivariate normal distribution described by a vector of means and a matrix of variances and covariances. At the lower level, each respondent's part-worth estimations are assumed to be related to their overall ratings of the crime profiles presented in the conjoint survey, by a linear regression model. Because each respondent is assumed to come from a population of similar individuals, when estimating parameters, information can be 'borrowed' from respondents. Such an approach enhances parameter estimation compared to

ordinary regression analysis; full details of the model are available in Sawtooth Software Inc. (2002). Data were further analysed using PAWS Statistics 18 (SPSS Inc., Chicago, USA). The mean preferences for attributes were compared on a common scale by calculating the ranges (highest to lowest) of the hierarchical Bayes estimations for all levels within an attribute, and dividing them by the sum of all the utility ranges (Home *et al.* 2009). Utility estimates were non-normal, so were analysed using non-parametric tests for differences between groups.

5.3 Results

Three surveys completed by members of the public were excluded from analysis because too few conjoint tasks had been completed. Following hierarchical Bayes analysis, 84 respondents across the three groups were excluded from further analysis due to low internal consistency of responses across conjoint tasks (correlation coefficient < 0.5) (Brocke et al. 2004). The final sample represents data from 226 conservation professionals, 176 magistrates and 193 members of the public. The gender ratio of those sampled was approximately equal for each group, with 50.9%, 51.3% and 47.2% female for conservation professionals, magistrates and the public, respectively. The median age of conservation professionals was 37 (inter-quartile range 17, n = 225), 61 for magistrates (inter-quartile range 11, n = 173), and 34 for the general public (inter-quartile range 22, n = 167). In terms of educational background, 89.8% (n = 203) of conservation professionals, 74.4% (n = 131) of magistrates and 63.7% (n = 123) of the general public were educated to degree level or higher. Compared to national statistics (Office for National Statistics 2008), our sample of the public are unrepresentative of the underlying population in terms of education level, as too many people educated to degree level or higher were sampled; we also oversampled people aged 20–24 and under sampled those aged 45–59 years (age categories derived from Office for National Statistics 2008). Compared to the magistrate population of England and Wales (Judiciary of England and Wales 2011), the only group where the sample data were unrepresentative of the underlying population was for magistrates aged 40–49 years, where too few were sampled.

The mean preferences (utility value) for wildlife trade crime attributes of the three groups (conservation professional, magistrates and the general public) were derived using hierarchical Bayes estimation and shown on a common scale (Figure 5.2). Magistrates and the general public placed most importance on the amount of illegal profit made by criminals, whereas conservation professionals placed most importance on the EU Annex of the species involved. Therefore it appears that magistrates and

the public initially considered how much profit the criminal made before considering other crime attributes, whereas conservation professionals thought first and foremost about the threat status of the species involved. There was a statistically significant difference between the three groups (n = 595) in the importance they placed on the taxon involved (Kruskal-Wallis test H = 69.1, $p < 0.001$), its EU Annex ($p < 0.001$), the illegal profit made ($p < 0.001$) and defendant's plea ($p = 0.05$). However there was no statistically significant difference between groups with respect to the importance they placed on defendants' previous convictions ($p = 0.75$).

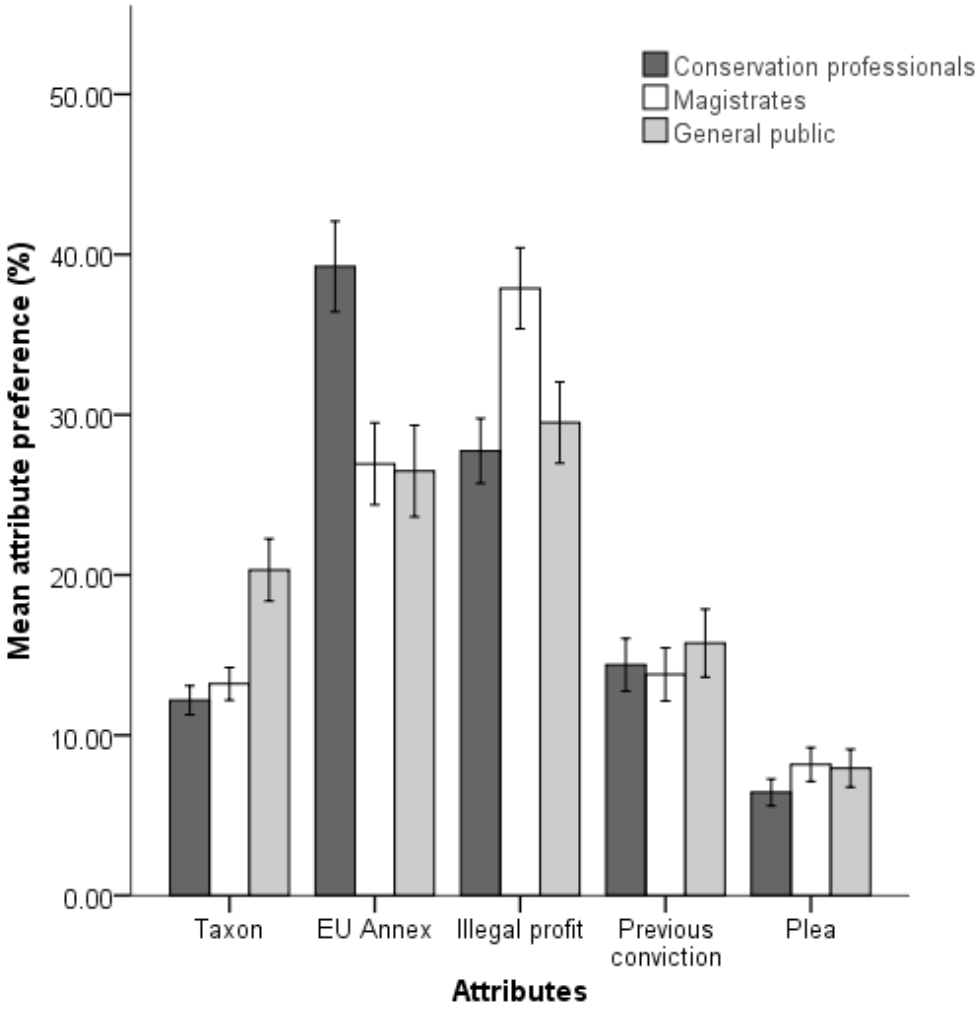


Figure 5.2 The relative importance of attributes (expressed as a percentage) of hypothetical wildlife trade offences as viewed by conservation professionals, magistrates, and the general public. Error bars show 95% confidence intervals.

Following illegal profit, magistrates and the general public both considered that the EU Annex of the species involved was the second most important attribute

determining the seriousness of a crime. The general public then considered taxon to be the third most important attribute, placing significantly greater importance on whether the species illegally traded was a mammal, bird, reptile or fish, than conservation professionals and magistrates. All groups considered the defendant's plea to be the least important attribute, however, both magistrates and the public, who did not differ significantly with respect to this attribute (Mann-Whitney *U* test 16 317.0, $p = 0.515$, $n = 369$), placed significantly greater importance on this attribute as compared to conservation professionals.

Results indicate that there are more discrepancies between the opinions of conservation professionals and either magistrates (differing significantly on EU Annex [Mann-Whitney U test $p < 0.001$], illegal profit [$p < 0.001$] and plea [$p = 0.002$]), or the public (differing significantly on taxon [$p < 0.001$], EU Annex [$p < 0.001$] and plea [$p = 0.016$]), than there are between magistrates and the public, who held significantly different opinions on just two attributes, namely taxon ($p < 0.001$) and illegal profit ($p < 0.001$).

The percentage of respondents aged above and below 45 years differed significantly by group ($\chi 2 = 188.33$, $p = < 0.001$, $n = 593$). Most magistrates (90.9%, $n = 160$) were ≥ 45 years old, whilst just 32.0% ($n = 72$) of conservation professionals and 26.6% ($n = 51$) of the public were ≥ 45 years old. To understand if differences in reported preferences for attributes between groups (Figure 5.2) were the result of differences in age, data gathered from each group were analysed to see if there were significant differences in attribute preference for respondents within groups aged above and below 45 years. There were no significant differences for conservation professionals (Mann-Whitney *U* tests: taxon $p = 0.266$; EU Annex $p = 0.096$; illegal profit $p = 0.426$; previous convictions $p = 0.993$; plea $p = 0.624$); magistrates (taxon $p = 0.688$; EU Annex $p = 0.789$; illegal profit $p = 0.253$; previous convictions $p = 0.186$; plea $p = 0.121$); or the public: (taxon $p = 0.889$; EU Annex $p = 0.469$; illegal profit $p = 0.374$; previous convictions $p = 0.943$; plea $p = 0.627$).

We analysed the degree of preference for each of the levels within each attribute (for example, within the attribute taxon, there are four levels: mammals, birds, fish and reptiles) (Figure 5.3). Within their most preferred attribute of illegal profit, magistrates and the general public placed most importance on criminals making an illegal profit of £ 100 000 (£ 1 = c. US$ 1.59 in Jan 2011); the more illegal profit the criminal stood to gain, the more serious these groups considered the crime to be.

Conservation professionals placed the most importance on the attribute EU Annex, and within this attribute they placed most importance on illegal consignments containing Annex A species; the higher the threat status of the species involved, the more serious conservation professional considered the crime to be. There were statistically significant differences between the three groups and the degree of preference they placed on different levels; for example, with respect to taxon, the public indicated a greater preference for mammals, and non-preference for fish, compared to conservation professionals and magistrates (Figure 5.3), namely they would punish a criminal illegally trading mammals more harshly than a criminal illegally trading fish, birds or reptiles.

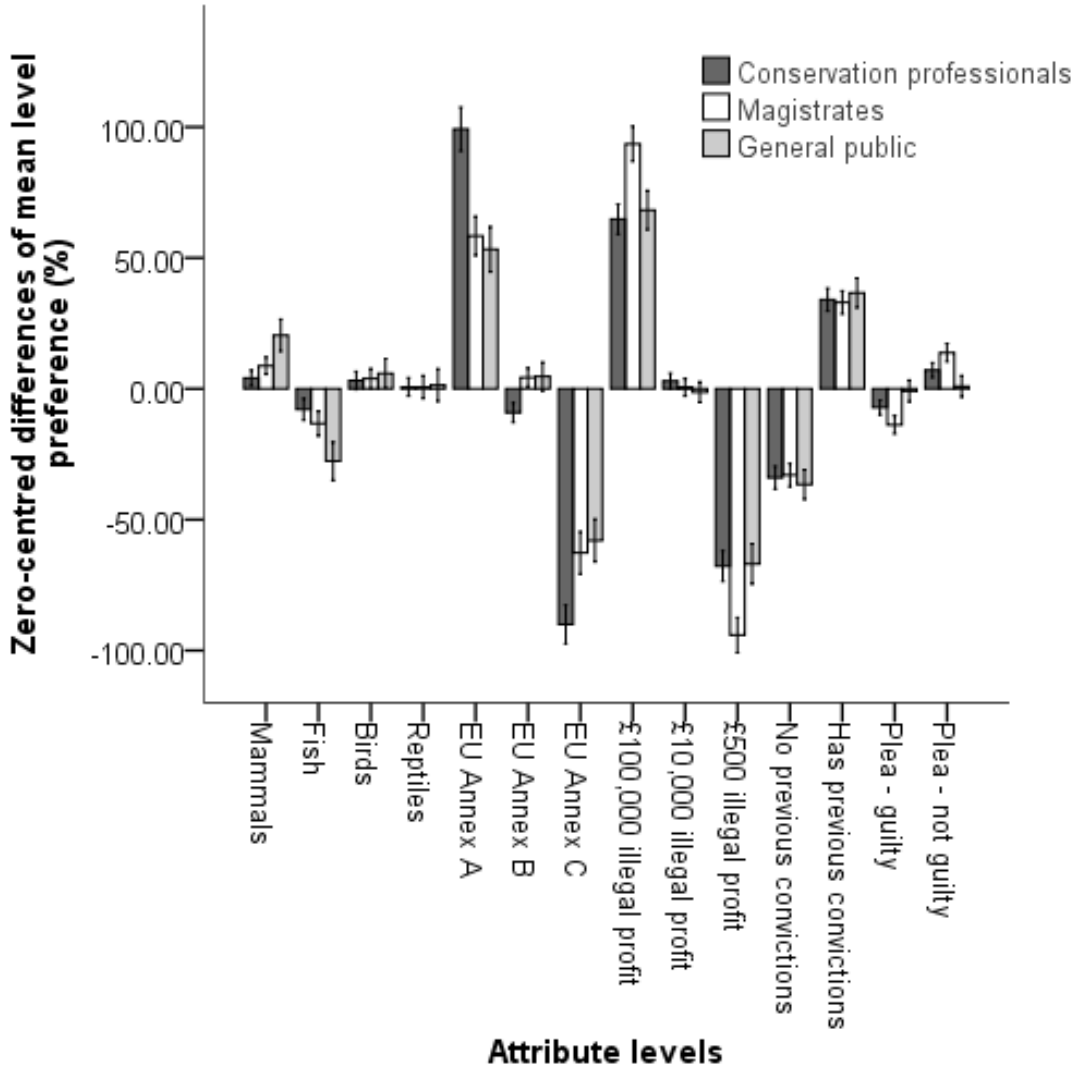


Figure 5.3 Relative preferences for levels within an attribute. Data are zero-centred such that the mean preference of all attributes within each level sum to zero. Error bars show 95% confidence intervals.

5.4 Discussion

This study is unique in presenting data from magistrates, as access to whom is heavily restricted, as well as conservation professionals and the general public, thus giving a range of perspectives on the sentencing of wildlife trade crimes. Our results show that magistrates placed most importance upon economic gains resulting from wildlife trade crimes. This is consistent with the manner in which they assess other more commonly processed offences for which sentencing guidelines exist, such as the evasion of alcohol or tobacco duty. In assessing the seriousness of such an offence, magistrates consider the level of duty evaded and the amount of personal profit made by the criminal, in addition to aggravating (for example repeated criminal offences, criminal played organizational role) and mitigating (for example timely guilty plea, criminal assisted police with inquiry) factors before deciding upon a sentence which must be within the range given in the guidelines (Sentencing Guidelines Council 2008). Similarly, given that conservation professionals are familiar with the potential threat that illegal wildlife trade poses to the continued existence of some species in the wild (Shivji et al. 2005; Shepherd and Nijman 2008), it is perhaps unsurprising that they considered the potential ecological impact of the offence to be the most serious aspect of the crime. It has been suggested that the public do not hold a coherent opinion regarding sentencing and that they are 'punitive sentencers' who focus only on the details of the harm done, ignoring characteristics of the criminal which may be mitigating (Durham 1993). However, more recent research suggests that, in determining which factors make a crime serious, there is a close fit between judicial practice and public opinion (Roberts et al. 2009). Our study reports similar findings, with few discrepancies between opinions of the public and magistrates in considering the relative importance of attributes affecting offence seriousness with respect to wildlife trade crimes. Indeed, our results suggest that the public are less punitive than conservation professionals, who showed greater insensitivity to mitigating characteristics of criminals.

Whilst magistrates place more importance on the illegal economic gain than on the conservation impact of the crime, economic value and rarity are related (Angulo et al. 2009). As such, by considering economic gain to be the key factor determining crime seriousness, by default magistrates may be punishing offences proportionally in accordance with the threat status of the species involved. However, because magistrates must judge criminals' ability to pay a fine and consider reducing sanctions in response to offender mitigation (such as a timely guilty plea), fines are

frequently lowered. Sanctions may thus become too low to act as an effective deterrent to repeat and future criminals, particularly those who stand to make considerable profit from illegally traded wildlife products such as white rhino horn, which may attract a price upwards of £ 30 000 kg-1 in China (UK Border Agency 2010).

Efforts to curb illegal wildlife trade need a clear understanding of how society, experts and those directly involved in punishing illegal wildlife trade view the seriousness of such crimes. This study presents findings from a single high-income country. Although only a single case study, it raises some important points with broader relevance. In common with the few other studies to directly investigate the attitudes of conservationists and the general public towards wildlife policy (Hanley et al. 2003; Koval and Mertig 2004), this study has identified differences in opinions between conservationists and non-conservationists. Whilst conservationists perceive the degree of ecological damage to be the most punishable attribute of a crime, the public and magistrates do not see the world this way, instead perceiving the size of economic gain to be the most punishable attribute of a crime. Such information can be used to improve the way in which conservationists communicate with others who do not share the same world view.

5.5 Conclusion

We have shown how conjoint analysis, most frequently used to identify which attributes of a product are most desirable to consumers, can be a useful tool for identifying differences between groups of people and their perspectives on policy issues, such as factors affecting the seriousness of a crime. Reducing wildlife trade crime may be critical to the persistence of many species. Our results suggest that magistrates, when presented with appropriate information on the conservation impact of wildlife trade offences, do consider the threat status and corresponding legal protection afforded to wildlife when considering offence seriousness, and that doing so is in line with public opinion. This study highlights the importance of ensuring that judiciaries are presented with information of the potential profit and conservation impact of wildlife trade crimes. We urge sentencing councils to develop appropriate guidelines to support judiciaries in their sentencing of wildlife crimes.

Chapter 6. Do sanctions reflect the conservation impact of wildlife crimes?

6.1 Introduction

Species declines and extinctions are widely attributed to human activities including over exploitation (Bradshaw et al. 2009; Stuart et al. 2004). Exploitation is often illegal, and wildlife crimes including the prohibited harming, killing, or collection of wild species, and the evasion of trade restrictions continue to threaten the existence of many species (Blundell and Mascia 2005; Shivji et al. 2005). Law enforcement, which includes the sanctioning of detected infractions, plays an important role in successful natural resource management (Keane et al. 2008).There is concern that sanctions for wildlife crimes do not vary with respect to the threat status and corresponding legal protection afforded to species, and that they do not reflect potential economic gains (Chaber et al. 2010; Eagle and Betters 1998; House of Commons 2004; Johnson 2010). As such, wildlife crimes may be viewed as low risk, high reward ventures for offenders (House of Commons 2004). Wildlife crime is generally under researched (Wilson-Wilde 2010) and, whilst some have investigated wildlife crime sanctioning (Alacs and Georges 2008) it is unclear how sanctions relate to the conservation impact of wildlife crimes.

In the United Kingdom wildlife crime is regulated by a suite of legislative levers including those which enforce the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES), and those which offer protection to the flora and fauna of the UK. Wildlife crimes may be prosecuted under one of three legal instruments: (1) the Customs and Excise Management Act 1979; (2) Control of Trade in Endangered Species (Enforcement) Regulations 1997; and (3) Wildlife and Countryside Act 1981. Violations of the European Union Wildlife Trade Regulation (EC) No. 338/97 which incorporates all of the provisions of CITES (Appendix 5), as well as additional stricter measures, occur under the Customs and Excise Management Act 1979 (CEMA) for offences detected at ports of entry to the UK. However, violations of this regulation detected within the UK should be prosecuted under the Control of Trade in Endangered Species (Enforcement) Regulations 1997 (COTES). Wildlife crimes which occur within the UK, involving non-CITES species are prosecuted under the Wildlife and Countryside Act 1981 (WCA).

Sentencing powers available to the courts differ depending upon which legislation wildlife crimes are prosecuted under (Table 6.1). Cases prosecuted under CEMA or COTES can be sent to Crown Court if a magistrate believes an offence warrants a higher penalty than can be awarded under their jurisdiction (this is not possible for cases prosecuted under the WCA). Of the three regulations, CEMA has the highest maximum sanctions. However, magistrates prosecuting offences under the WCA have

the sentencing power to award penalties in respect of every single specimen involved in the offence as if each were a separate offence.

Table 6.1 Legislation protecting wildlife (Magistrate's Association 2009)

Legislation	Penalty
The Customs and Excise Management Act 1979 (CEMA)	… a person guilty of an offence under this section shall be liable - (a) on summary conviction[a], to a penalty of the prescribed sum or of three times the value of the goods, whichever is the greater, or to imprisonment for a term not exceeding 6 months, or to both; or (b) on conviction on indictment[b], to a penalty of any amount, or to imprisonment for a term not exceeding [7 years] or to both.
The Control of Trade in Endangered Species (Enforcement) Regulations 1997 (COTES)	(8) A person guilty of an offence shall be liable - (a) on summary conviction[a], to a fine not exceeding level 5c on the standard scale or to a term of imprisonment not exceeding six months, or to both; and (b) on conviction on indictment[b], to a term of imprisonment not exceeding five years or to a fine, or to both.
The Wildlife and Countryside Act 1981 (WCA)	21(1) Subject to subsection (5), a person guilty of an offence shall be liable on summary convictiona to imprisonment for a term not exceeding six months or to a fine not exceeding level 5[c] on the standard scale, or to both. 21(5) Where an offence to which subs (1) applies was committed in respect of more than one bird, nest, egg, other animal, plant or other thing, the maximum fine which may be imposed … shall be determined as if the person convicted had been convicted of a separate offence in respect of each bird, nest, egg, animal, plant or thing.

[a] Sentenced at Magistrates court.

[b] Sent to Crown Court where power of sentencing is greater.

[c] Level 5 maximum value £5,000 (Sentencing Guidelines Council 2008).

When hearing cases magistrates follow steps laid down in sentencing guidelines which state what sanctions are available for different types of offences. The first step is to assess offence seriousness for example, consider the evasion of alcohol duty: what was the value of tax evaded? The second step is to consider aggravating and

mitigating factors: the defendant played an organisational role (aggravating); or, the defendant played a minor role (mitigating). Magistrates use such information to form a preliminary view of the appropriate sentence; they must then consider reducing the sentence if the defendant pleaded guilty. Further, in order to equalise the impact of sanctions on defendants, magistrates must consider the financial circumstances of the offender when deciding upon a sentence (Sentencing Guidelines Council 2008). Wildlife crimes are not included in the Magistrates' Court Sentencing Guidelines (see Chapter 5 for a discussion of sentencing wildlife crimes in magistrates' courts of England and Wales).

Whilst sentencing powers available to the courts in the UK are considered sufficient (House of Commons 2004; The Scottish Government 2008), it is unclear if sanctions vary with respect to the conservation impact of crimes. This study explores sanctions awarded within the UK for wildlife crimes prosecuted over a 23 year period from 1987 to 2010 focusing on the relationships between sanction severity and the conservation impact of offences as determined by the protection status (CITES or WCA) of the specimens involved in the crimes.

6.2 Methods

Wildlife crimes resulting in cautions or prosecutions are not classified as recordable meaning they are not recorded on any central government system (House of Commons 2004), as such they cannot be accessed in this manner. Records of UK wildlife crime prosecutions were provided by TRAFFIC the wildlife trade monitoring network and the Royal Society for the Protection of Birds (RSPB). Additional prosecution records were found within the Bat Conservation Trust's annual crime reports. These organisations collate prosecution information when they know cases are being presented in courts either because they are involved in the cases, or are informed of cases by other agencies. Given the level of effort dedicated by these organisations in collating data on wildlife crime prosecutions within their specialist areas we make the assumption that these data represent a census of wildlife trade, bird, and bat prosecutions for the years where data were available (TRAFFIC: 1987 – 2010; RSPB: 1995 – 2009, and Bat Conservation Trust: 2000 – 2006).

Each wildlife crime prosecution was coded to allow for comparison between prosecutions (Table 6.2). The right hand column of Table 6.2 illustrates how the prosecution record presented in Box 6.1 was coded when entered into PASW Statistics (Predictive Analytics SoftWare Statistics, IBM, New York, USA).

Box 6.1 An example wildlife crime prosecution record provided by TRAFFIC

Southwark Crown Court, 2001. Species involved: tantalus monkey (*Chlorocebus tantalus*), African pangolin (*Smutsia temminckii*), rock python skin (*Python molurus*), and monitor skins (*Veranus* spp.). Protection status: CITES Appendix II, EU Annex B. Prosecuted for possession and trade in illegally imported goods under Section 170 of the Customs and Excise Management Act 1979. Penalty: four months imprisonment.

Table 6.2 Coding of prosecution details

Variable name	Variable details	Example case: from Box 6.1
ID	Case ID number sequentially assigned when entering data	79
Data source	TRAFFIC RSPB Bat Conservation Trust	TRAFFIC
Year of prosecution	Year	2001
Country of prosecution	England and Wales Scotland	England and Wales
Regulation	COTES CEMA WCA Other	CEMA
Case details	Details of specimens involved in offence, and type of offence	(1) Tantalus monkey (*Chlorocebus tantalus*), (2) African pangolin (*Smutsia temminckii*), (3) Rock python skin (*Python molurus*), (4) Monitor skins (*Varanus* spp.)
Protection status (CITES)	Appendix I Appendix II WCA	Appendix II
Protection status (EU Annex)	Annex A	Annex B

Variable name	Variable details	Example case: from Box 6.1
	Annex B	
	WCA	
Taxon	Bird	Mixed taxa
	Mammal	
	Reptile / Amphibian	
	Fish	
	Plant	
	Arthropod	
	Mixed taxa	
Number of specimens	One specimen	Multiple specimens
	Multiple specimens	
Potential illegal Profit	Illegal profit value available	Not available
	Illegal profit value not available	
Sanction type	Prison	Prison
	Suspended prison	
	Fine	
	Community service order	
	Conditional discharge	
	Youth referral order	
	Other	
	Admonished	
	Absolute discharge	
Prison sentence duration	Numeric value (months)	4
Fine (GBP) as recorded in the year of prosecution	Numeric value (GBP)	Not applicable (-1)
Fine (GBP) corrected for inflation to 2010 values	Numeric value (GBP)	Not applicable (-1)
Community service order duration	Numeric value (hours)	Not applicable (-1)

Prosecutions frequently involved multiple wildlife specimens from multiple CITES or EU Annexes; in such instances prosecutions were coded according to the highest CITES Appendix, and EU Annex contained within illegal consignments. Some

prosecutions were punished with multiple sanctions; such prosecutions were coded according to the toughest sanction awarded (in declining order: prison, suspended prison, fine, community service order, conditional discharge, youth referral order, other, admonished, and absolute discharge). So that the financial value of fines could be compared across years, all fines were adjusted to take account of inflation using the Retail Price Index Table RP02 using the following formula: Sum of money (GBP) x (Later date RPI / Earlier date RPI; 2010) (Office for National Statistics 2011).

Data analysis

To examine the relationship between protection status and the severity of different types of sanctions; and with respect to WCA offences, the affect of single and multiple specimens on sanction severity; non-parametric kernel distribution plots were made using R v. 2.12.0 (R Development Core Team 2010). Kernel distribution plots are one way of displaying the distribution of random continuous variables based upon their probability density function, i.e. the relative likelihood of the random variable occurring at a given point (Scott et al. 2001).

6.3 Results

Cases that were dismissed upon reaching court (n = 16), or where the defendant was declared not guilty (n = 42) were not considered in the analysis; a further 85 cases were excluded from analysis because, whilst being offences under the WCA, they did not involve an animal or plant species directly (e.g. the defendant was found to possess egg collecting equipment which could be used to commit an offence). The remaining sample described contains 696 wildlife crimes (542 from RSPB, 139 from TRAFFIC, and 15 from The Bat Conservation Trust) which were prosecuted between 1987 and 2010. Most offences involved birds (85.4%, n = 595), possibly reflecting the source of the data, while 5.5% (n = 38) involved mammals, 3.0% (n = 21) involved reptiles or amphibians, 0.9% (n = 6) involved plants, 0.3% (n = 2) involved fish, 0.1% (n = 1) involved arthropods, 3.2% (n = 22) involved multiple taxa while taxa were unknown for the remaining 1.7% (n = 12) of cases. The proportion of prosecutions for each taxon, split by protection status are presented in Figure 6.1.

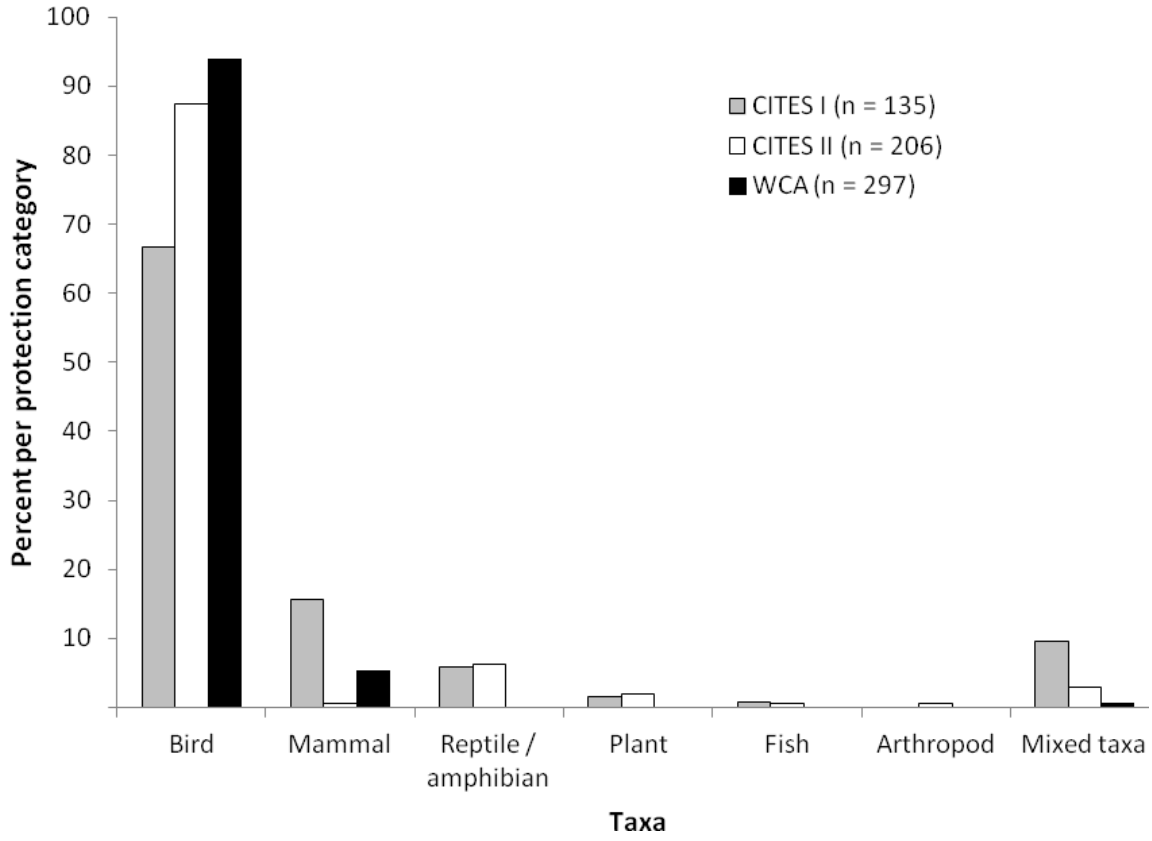


Figure 6.1 The proportion of prosecutions for each protection status presented by taxon. For each protection status, most prosecutions were for offences involving birds.

Legal instrument

The majority of prosecutions (54.9%, *n* = 382) were made under the WCA; 20.1% (*n* = 140) were made under COTES; 7.2% (*n* = 50) were made under CEMA; 3.9% (*n* = 27) of prosecutions occurred under other legal instruments including the Conservation (Natural Habitats) Regulations 1994 and various animal protection and animal health acts. It was not possible to identify which regulation the remaining 13.9% (*n* = 97) of prosecutions were made under.

Protection status: EU Annexes, CITES Appendices and the WCA

Nearly half of the prosecutions (49.8%, *n* = 347) involved CITES and EU Annex listed species, and 42.7% (*n* = 297) were offences under the WCA (e.g. injuring, killing or taking a bird from the wild). There was insufficient species information to assign protected status to the remaining 7.5% (*n* = 52) of cases. This does not necessarily mean that this information was not made available to the courts.

In many instances trade restrictions under the EU Annexes are stricter than CITES. For example Eleonora's falcon (*Falco eleonorae*) is listed on Annex A of the EU regulations (akin to CITES Appendix I), yet is listed on Appendix II of CITES. For this reason whilst the total number of prosecutions known to involve specimens listed under the EU Regulations and the Convention is the same (*n* = 347), the proportion of prosecutions involving Annex A, or CITES Appendix I specimens differs. In terms of the EU regulations 91.6% (*n* = 318) of the defendants prosecuted committed offences involving Annex A species; whilst 8.4% (*n* = 29) of defendants were prosecuted for offences involving Annex B species. However, in terms of CITES, 40.3% (*n* = 140) of defendants were prosecuted for offences involving Appendix I species; whilst 59.7% (*n* = 207) were prosecuted for offences involving Appendix II specimens. Because CITES is a global Convention, we explored the relationship between sanctioning and the level of legal protection violated in respect of CITES, rather than EU Annexes. In addition we explore the sanctioning of non-CITES offences i.e. acts considered crimes under the WCA.

Types of sanctions awarded

The most common form of sanction awarded was a fine (57.5%, *n* = 400, this includes three defendants who also received conditional discharges), followed by a conditional discharge (16.7%, *n* = 116). In 9.8% (*n* = 68) of cases offenders were sentenced to time in prison (this includes one offender who also received an 18 month suspended prison sentence; one who also received a conditional discharge; three who were also fined; and three who also received community service orders). Just over six percent (6.3 %, *n* = 44) of offenders were awarded community service orders whilst 2.7% (*n* = 19) of offences involved youths who were awarded youth referral orders. Just over two percent (2.4%, *n* = 17) of offenders received suspended prison sentences and 0.7% (*n* = 5) received other types of sanctions such as curfew orders. Over two percent (2.6%, *n* = 18) of cases were admonished (defendants were found guilty, but the offences were considered minor so defendants were dismissed with a reprimand), and 1.3% (*n* = 9) of cases received an absolute discharge (the court considered it unsuitable to inflict punishment).

The type of sanction awarded differed with the protection status of the specimens involved in the offence, for example, prison sentences were more frequently awarded for offences involving CITES Appendix I specimens (Figure 6.2).

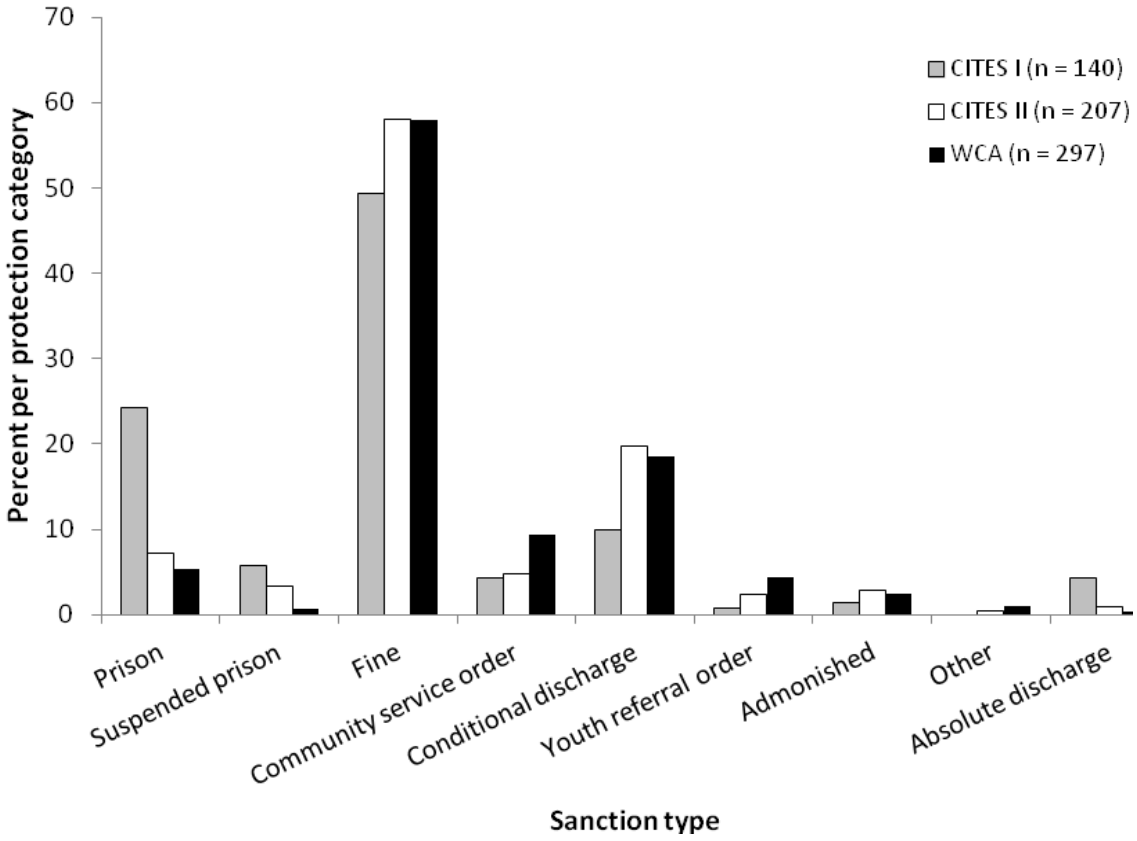


Figure 6.2 The proportion of prosecutions for each protection status awarded different types of sanctions.

Sanction severity and protection status

Data regarding the second most common form of sanction (conditional discharge) was insufficiently detailed for inclusion in the analysis to follow; the duration of the charge was usually unavailable, only a yes / no report as to weather a conditional discharge was awarded. The study focused instead on the first (fine), third (prison), and fourth (community service), most commonly applied types of sanctions which account jointly for 73.6% (n = 512) of all sanctions awarded for wildlife crimes. Kernel distribution plots illustrate how the severity of these three types of sanctions differed with protection status (Figure 6.3). The kernel densities indicate that sanctions awarded for offences involving CITES Appendix I species were greater than sanctions awarded for offences involving Appendix II species, or offences under the WCA. For example the kernel densities for imprisonment (Figure 6.3, top) show that all WCA offences that received prison sentences were distributed between one and six months, whereas the distribution of prison sentences for Appendix I offences spreads from 1.5 to 78 months, with a peak at four months indicating that this was

the sentence duration most frequently awarded. Summary distribution details of the data displayed in Figure 6.3 are presented in Table 6.3.

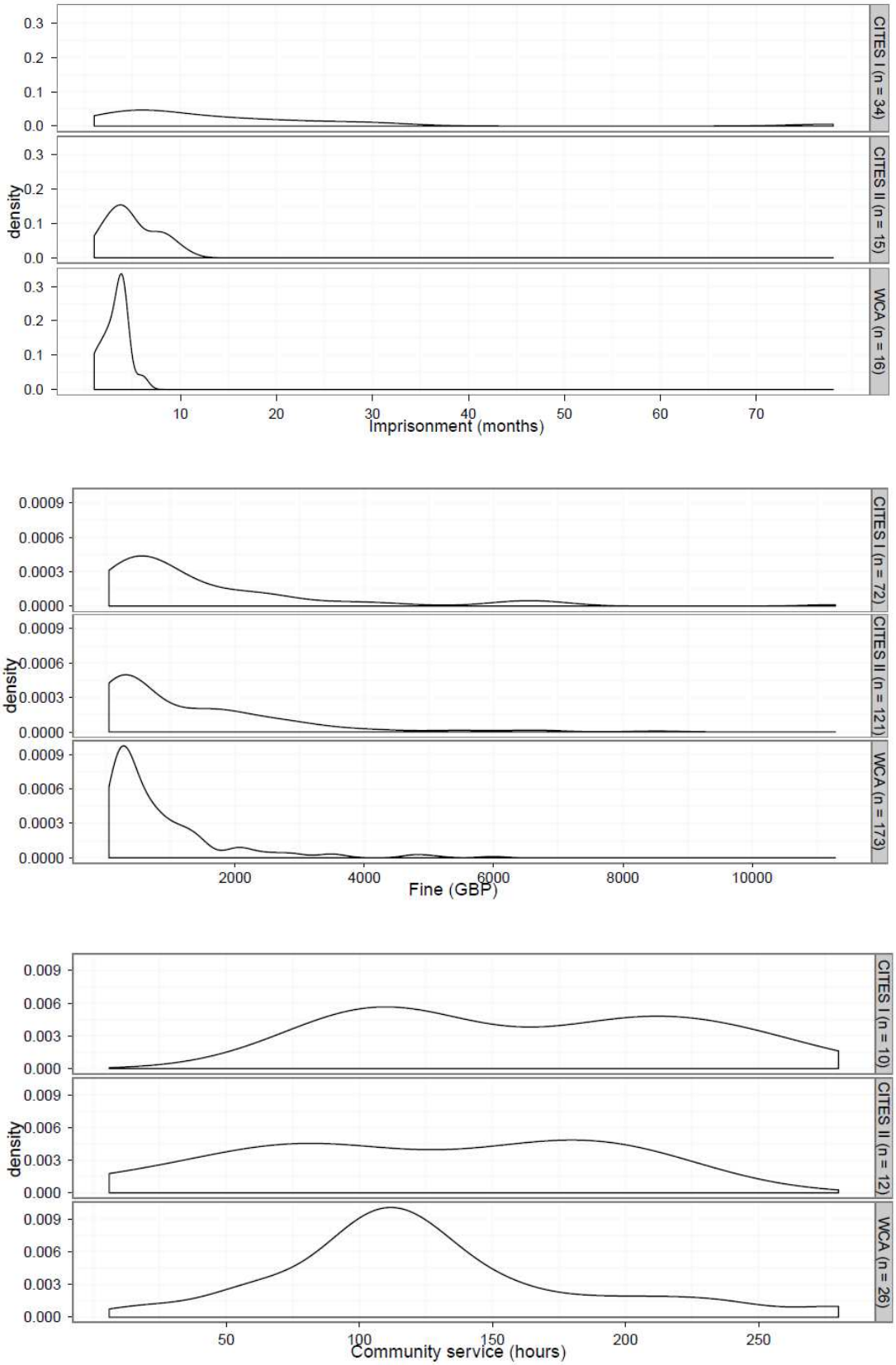


Figure 6.3 Distribution of prison sentences, fines, and hours of community service awarded to defendants found guilty of committing offences in respect of CITES Appendix I or II species, or offences under the Wildlife and Countryside Act.

Table 6.3 Summary distribution of sanction severity of Appendix I, II, and WCA offences

	Appendix I	Appendix II	WCA
Imprisonment (months)			
Minimum	1.5	1.5	1
Maximum	78	10	6
Median	9.5	4	3.75
n	34	15	16
Fine (GBP)			
Minimum	65	48	62
Maximum	11,287	8,518	5,988
Median	852	676	466
n	72	121	173
Community service order (hours)			
Minimum	100	6	18
Maximum	250	200	280
Median	160	125	120
n	10	12	26

Sanction severity and quantity of specimens – WCA offences

Kernel densities indicate that the severity of sanctions awarded for offences under the WCA differed with the number of specimens involved in the offence (Figure 6.4). For each of the three sanction types, harsher sanctions were awarded for offences involving multiple, rather than single specimens. For example the kernel densities for community service orders (Figure 6.4, bottom) peak at 100 hours for offences involving single specimens, and 120 hours for offences involving multiple specimens showing that these were the most frequently awarded sentence durations for offences involving single and multiple specimens. Summary distribution details of the data displayed in Figure 6.4 are presented in Table 6.4.

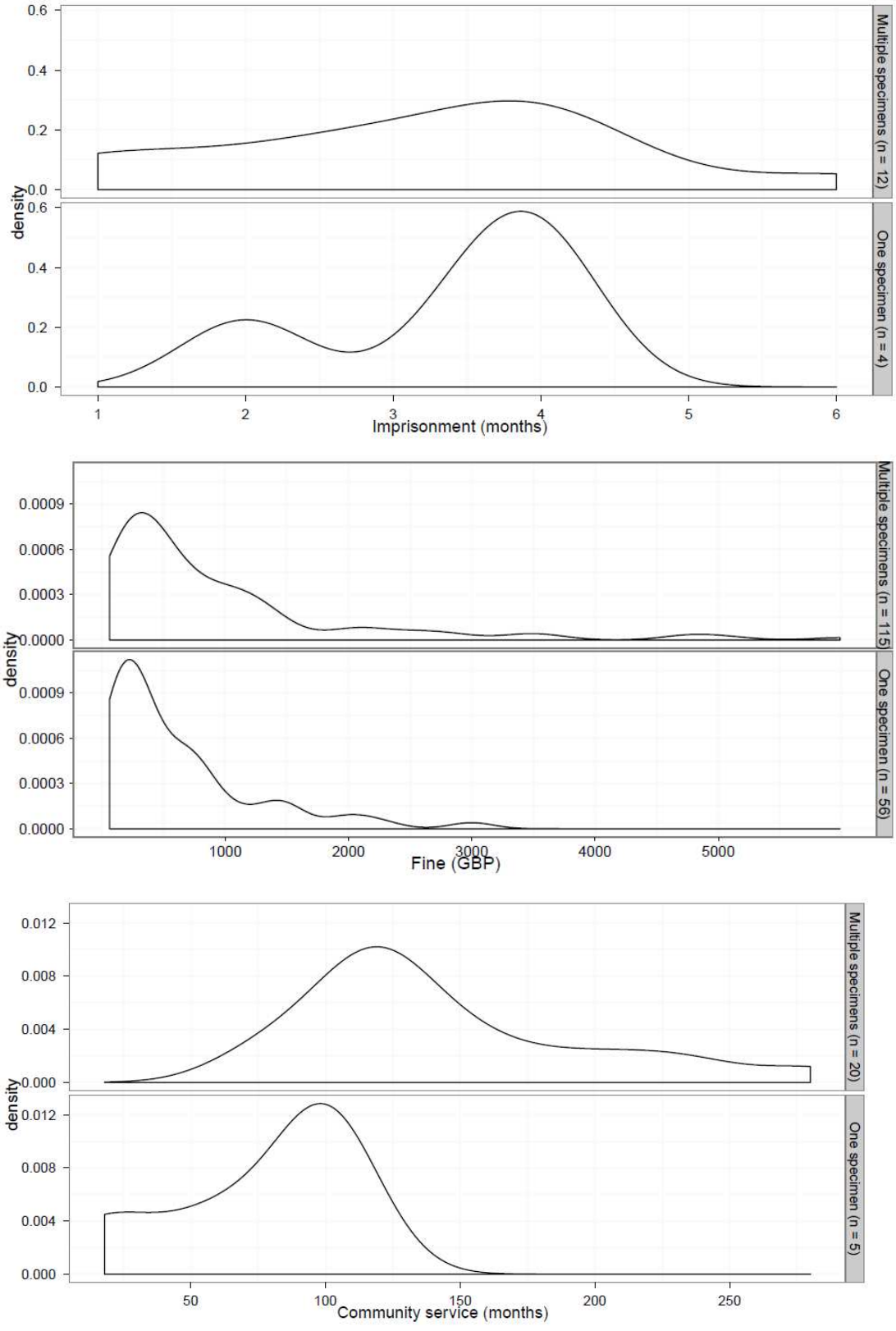


Figure 6.4 The distribution of prison sentences, fines, and hours of community service awarded to defendants found guilty of committing offences under the Wildlife and Countryside Act involving multiple, and single specimens. Larger sanctions were awarded for offences involving multiple, rather than single specimens.

Table 6.4 Summary distribution of sanction severity for WCA offences involving multiple and single specimens

	Multiple specimens	Single specimen
Imprisonment (months)		
Minimum	1	2
Maximum	6	4
Median	3.5	3.75
n	12	4
Fine (GBP)		
Minimum	69	62
Maximum	5,988	2,999
Median	525	341
n	115	56
Community service order (hours)		
Minimum	70	18
Maximum	280	100
Median	120	100
n	20	5

6.4 Discussion

Human activities including the exploitation of wildlife, which in some instances is criminal, pose a threat to global biodiversity (Agnew et al. 2009; Bulte and Horan 2003; Laurance et al. 2004). Wildlife crimes may be viewed as thefts of public resources (Wilson-Wilde 2010) and punishing wildlife criminals is one way of reimbursing society's losses. There is concern that sanctions for wildlife crimes do not vary appropriately with the threat status of species (Eagle and Betters 1998), fail to reflect conservation damage, and may be an inadequate deterrent (House of Commons 2004). Whilst some work has looked at how awarded fines relate to economic values that people place on species survival (Eagle and Betters 1998), and how sentencing strategies might affect behaviour (Milner-Gulland and Leader-

Williams 1992), there appears to be a lack of empirical analysis on how sanctions awarded for actual wildlife crimes relate to conservation impact.

This study investigated the relationship between the conservation impact of wildlife crimes and the severity of sanctions awarded by courts in the UK over a 23 year period. The results suggest that sanctions vary with respect to the protection status of the species involved. Prison sentences, and suspended prison sentences, the harshest sanctions available, were most frequently awarded for crimes against the most highly protected species which are listed on Appendix I of CITES. Longer prison sentences were awarded for crimes involving Appendix I species, than for crimes which did not. Alternative types of sanctions, such as fines and community service orders, were more frequently used to sanction crimes which had a lower conservation impact (Appendix II, or WCA offences). However, as with prison sentences, the highest fines and longest community service orders were awarded for crimes involving Appendix I species. Offences under the WCA which involved multiple specimens received higher penalties compared to offences involving single specimens, suggesting that magistrates were using their sentencing powers to punish offenders for each wildlife specimen against which an offence had been committed.

Whilst the finding that sanctions vary with protection status is positive, sanctions awarded for wildlife crimes may not be sufficient to deter offenders, particularly those who stand to make considerable profits (Cook et al. 2002). Most wildlife crimes were prosecuted under COTES or the WCA which have lower maximum penalty limits for wildlife crimes compared to countries such as America (criminal penalties of up to US$50,000 (~£30,700) and / or up to one year in prison; civil penalty of up to US$25,000 (~£15,400)), or Australia (AUD$ 110,000 (~£74,200) and / or up to ten years in prison). Further, because UK judiciaries must consider an offender's ability to pay a fine, and consider reducing sanctions in response to offender mitigation (e.g. timely guilty plea, helpful during police enquiries), fines are frequently lowered (Sentencing Guidelines Council 2008). As a result, sanctions may be too low to act as an effective deterrent when the economics of committing a criminal offence are taken into account (e.g. high returns, and low probability of detection and conviction) (Robinson et al. 2010). For example, in 2000, an offender prosecuted under COTES for possessing 138 shahtoosh shawls made from the hair of Tibetan antelope (*Pantholops hodgsonii*), listed on Appendix I of CITES was fined £1500; the estimated value of the shawls was £353,000.

The analysis was restricted by the data. For example, when setting sentences, magistrates must consider aggravating and mitigating circumstances, as well as the offenders' financial circumstances. Such information was not available making it problematic to fully model actual sentencing decisions. Most offences prosecuted in the UK during the period covered by this study involved birds. This does not necessarily reflect the types of crimes being committed but may reflect available data sources, and perhaps differences in the probabilities of detection and prosecution. Police Wildlife Crime Officers now exist in most UK police forces, and the RSPB promote the reporting of suspected bird-related crimes (RSPB 2011) and have an investigation team which works together with the National Wildlife Crime Unit, police forces, and other agencies to help catch wildlife criminals. Conversely, Her Majesty's Customs and Excise, responsible for enforcing the EU Wildlife Trade Regulations no longer have designated CITES Wildlife and Endangered Species Officers in each customs region (House of Commons 2004). Instead they have adopted an intelligence-led approach and depend heavily upon a small team of CITES specialists based at Heathrow Airport (House of Commons 2004). The number of prosecutions involving taxa other than birds was too low to allow me to investigate the impact of taxon on sanction severity. As such it is unknown if the level of charisma associated with different taxa influenced sentencing decisions as it has been shown to influence other factors such as donor support (Sergio et al. 2006). However, results from Chapter 5 suggest that such an influence is unlikely to be present. Due to the sensitive nature of the topic, obtaining reliable information on the black market value of wildlife products is challenging (Stiles and Martin 2001), yet in the absence of such information, it is impossible to investigate how sanctions relate to the potential profits that criminals stand to make from their illicit trade. Gaining data on black market values requires further attention if this relationship is to be understood.

6.5 Conclusion

Reducing wildlife crime may be critical to the survival of many species. Results suggest that judiciaries consider the conservation impact of wildlife crimes when sentencing wildlife criminals (both the protection status, and whether a crime involved single, or multiple specimens, influenced sanctioning). However, concern remains as to how sanctions relate to the illegal profits, and therefore how effective current sanctioning is at deterring wildlife crimes, particularly those which are highly profitable.

Chapter 7. Discussion

7.1 Background

Globally human activities including deforestation, land-use change, and the burning of fossil fuels exert such sizeable impacts upon the Earth that they rival some forces of Nature. The impact of our activities is so great that the epoch in which we live has been described as the Anthropocene (Crutzen 2002; Steffen et al. 2011). In some instances resource use is illegal. Over time, different types of interventions have been implemented in an attempt to curb transgressions. For example, protected areas have adopted fences and fines approaches, using guards to monitor prohibited access, distributing penalties to rule breakers, whilst integrated conservation and development projects have offered alternatives sources of sustenance or income in an attempt to reduce illegal offtake (Barrett and Arcese 1995). Whatever the approach, one factor is central: success depends upon influencing environmentally harmful behaviours committed by people.

7.2 Contributions of this thesis

When I started this PhD I felt that studying rule breaking in conservation was somehow taboo. To suggest that people living near natural resources that various conservation bodies and authorities were promoting the conservation of might be breaking rules seemingly contradicts the dominant ethos of the various community-centred approaches to conservation. Particularly as such approaches may tend to promote the image of local people willingly engaging in pro-conservation behaviours, whilst refraining from environmentally harmful ones. However, many approaches to conservation and natural resource management, including relatively new initiatives such as payment for ecosystem services schemes depend upon rules (Sommerville et al. 2010) and require information about compliance. Recently there has been greater discussion of rules and rule breaking in the conservation and natural resource management literature (Blank and Gavin 2009; Gavin et al. 2010; Keane et al. 2008; Robinson et al. 2010; Solomon et al. 2007), and this thesis contributes to research in this area.

Part One

Understanding human behaviour

This thesis has reviewed theories of human decision making from social psychology, discussing the types of predictors used to investigate drivers of human behaviour, and how such predictors have been studied in conservation and natural resource

management. Chapter 2 draws together a broad span of research from within conservation covering work on social norms and taboos, as well as research on attitudes of people subjected to conservation interventions including community conservation programmes and protected area rules. The key contribution of this chapter has been to offer clarification as to why research into general attitudes in conservation has produced mixed evidence of the relationship between attitudes and behaviour. Drawing on lessons learned in social psychology Chapter 2 offers suggestions on how research in this area may be improved to produce results which may usefully inform the design of interventions aimed at influencing behaviour. For example by identifying which underlying beliefs (attitude, social influences, or perceived and actual availability of resources) best explains someone's intention to perform, or refrain from performing, a specific behaviour which will impact upon conservation success. My suggestions that data collection on attitude may be improved by investigating attitude towards a specific behaviour of conservation interest (e.g. poaching), rather than towards conservation in general; more specifically defining the behaviour of interest in terms of target, action, context, and timescale; and linking attitudes to an actual measure of behaviour were empirically tested in Chapter 4.

There is evidence, both within and beyond our field, that attitude alone is a poor predictor of peoples' behaviour (Infield and Namara 2001; Waylen et al. 2009). As such, if the intention is to conduct research that may inform the design of interventions aimed at influencing behaviour, studies making the assumption that general attitudes (towards a species, habitat, project or other conservation-related topic) are useful proxy indicators of pro-conservation behaviour are redundant. Moving forward, studies should strive to establish the link between drivers of decision making such as people's attitudes and norms, and their actual engagement, or intention to engage in specific behaviours which impact upon the success of conservation objectives. For example, Cavalcanti et al. (2010) use the theory of planned behaviour (TPB) to investigate the relative importance of social psychological drivers of behaviour at predicting peoples' intention to kill jaguar (*Pantera onca*) in the northern Pantanal, Brazil. Whilst Williams et al. (in review) use the TPB as a theoretical framework to assess the impact of training (which aimed to encourage the cultivation of an over-harvested palm species xaté (*Chamaedorea ernesti-augusti*)), to examine which factors (attitude, subjective norms, perceived behavioural control, and knowledge) determine peoples' actual cultivation of xaté in forest-edge communities in Belize. The results of Cavalcanti et al. (2010) suggest that the social

acceptability of, and attitudes towards jaguar killing were both important predictors of peoples' intention to perform an environmentally harmful behaviour – killing jaguars. However, the results of Williams et al. (in review) suggest that respondents' technical knowledge and perceived behavioural control, along with factors such as forest-ownership, were important predictors of the pro-conservation behaviour of xaté cultivation. Note, the relative importance of the drivers of human decision making differed from one behaviour to another. It cannot be assumed that a) attitude alone is a useful predictor of behaviour, or b) that attitude is the most useful predictor of behaviour.

Novel methods for assessing rule breaking

An important contribution of this thesis has been to test novel methods for directly assessing rule breaking in conservation by asking members of the public, some of whom may be rule breakers, to respond to sensitive questions. Rarely do studies measuring illegal resource use compare results from different methods (Gavin et al. 2010). In Chapter 3 I compared the level of reported rule breaking using three methods: an anonymous self-complete questionnaire, the nominative technique, and the randomised response technique (RRT). Both the nominative technique and RRT have been used in other disciplines to estimate the prevalence of sensitive behaviours (e.g. drug abuse, and illegal abortions) but rarely have such specialised methods been used to investigate rule breaking in conservation where there has been a tendency to depend upon questionnaires delivered through face-to-face interviews (Table 3.1, Chapter 3). Studying rule breaking by local fly fishers provided an ideal opportunity to test different methods of directly assessing rule breaking. The nominative technique, previously only used to investigate illegal drug use (Miller 1985) did not perform well. However, as reported in other comparative studies, I found that RRT returned significantly higher estimates of rule breaking than did the anonymous self-complete questionnaire. This suggests that whilst anonymity may increase reporting, other mechanisms can further increase the validity of sensitive data. As explained in Chapter 3, the principle disadvantage of RRT is that compared to conventional methods, RRT requires larger sample sizes to get estimates with an acceptable level of error (due to random noise added to the data by instructing a known proportion of respondents to provide forced responses). However, my results suggest that this compromise in efficiency is more than compensated for by the apparent increase in data validity.

Results presented in Chapter 3 suggest that considerable revenue may be being lost to the Environment Agency as a result of fishers failing to comply with the legal

requirement to hold a valid rod license. Results also suggest that revenue is being lost by fishery owners as some fisher's abuse the requirement to pay for each day of fishing. Armed with such information authorities and managers can decide upon the most appropriate and viable course of action to improve compliance. However, in the absence of information on rule breaking natural resource managers have a restricted ability to enforce rules efficiently, for example through targeted enforcement interventions or increasing knowledge of rules. However, as discussed in this thesis (Chapters 3 and 4), investigating sensitive topics directly by surveying members of the public, is problematic, being subject to social desirability and non-response biases. Developed in the social sciences (Warner 1965) RRT is one example of a risk-reducing method designed specifically for gathering sensitive data directly from people which, in comparative studies (Solomon et al. 2007; Chapter 3 of this thesis), and validation studies (Tracy and Fox 1981; Lensvelt-Mulders et al. 2005b) outperforms conventional anonymous survey techniques. The apparent gains in data validity achieved through RRT suggest that the method could be more widely used to gather information on rule breaking in conservation, for example studies of poaching. However, future applications of RRT could be more efficient than the one applied in Chapter 3. In this study respondents were instructed to answer the sensitive question when one die landed on 1, 2, 3, or 4, and to say 'yes' when the die landed on 5, and to say 'no' when it landed on 6. Therefore the probability of respondents being required to answer the sensitive question was 4/6 or 0.667. Increasing the probability of respondents answering the sensitive question increases the efficiency of RRT as a greater proportion of respondents are required to answer the sensitive question. However, setting the probability too high, for example above 0.75, which is the probability associated with answering sensitive questions in Chapter 4, may eliminate the protection perceived by respondents participating in RRT surveys.

Identifying potential non-sensitive indicators of involvement in illegal behaviours

Despite the promise of the few studies which have used RRT to estimate levels of rule breaking in conservation and natural resource management (e.g. Blank and Gavin 2009; Solomon et al. 2007; and Chapter 3 of this thesis) the application of RRT has been limited to assessing the population-level prevalence of sensitive behaviours and has not linked characteristics of people, such as their attitudes, xaté to their actual behaviour. As a result, identifying groups of people (for example, those who hold negative attitudes towards carnivores on their land) to target with interventions aimed at changing behaviour remains problematic. Chapter 4 of this thesis took a major step forward, paving the way for using RRT to test the

effectiveness of innocuous questions at identifying people's involvement in illicit behaviours. The research on carnivore persecution presented in Chapter 4 is novel on a number of accounts: drawing on lesson from social psychology, behaviour specific attitude statements (as suggested in Chapter 2) were developed in order to empirically test the relationship between a person's attitude, and their involvement in the sensitive behaviour under investigation (reported via RRT). The effectiveness of how sensitive behaviours were perceived to be in respect of prevailing social norms was also tested as an indicator of behaviour. In addition, this was the first study within conservation and natural resource management to test the potential of the psychological bias known as the false consensus effect (Ross et al. 1977) at indicating a person's involvement in sensitive activities. In addition to providing estimates of the proportion of farmers killing carnivores (including the legally protected leopard (*Panthera pardus*) and brown hyaena (*Parahyaena brunnea*)) on their ranches, results of Chapter 4 provide evidence that clearly specified attitude statements can be a useful indicator of behaviour. Further, data from this study supports the suggestion by Petroczi et al. (2008) that a person's estimate of the proportion of their peers involved in sensitive behaviours can be a useful indicator of a person's own involvement in that behaviour.

The identification of non-sensitive indicators of people's involvement in illicit behaviours is an initial step towards identifying innocuous questions, the answers to which can be related to people's involvement in illegal or otherwise sensitive behaviours. Armed with information on innocuous characteristics of people most likely to break rules, resource managers may better direct their limited resources towards influencing non-compliant behaviour. This is not to say that respondents could be individually profiled and targeted with interventions such as penalties for rule breaking. Even if this were possible (it is not via RRT), such action could be viewed as an unethical abuse of trust between researcher and respondent. Rather, information concerning social psychological characteristics associated with behaviour, for example negative attitudes towards carnivores, may be used to inform the design of interventions designed specifically to influence characteristics (e.g. attitude) associated with driving environmentally harmful behaviours, which should ultimately influence behaviour. Examples of effective interventions include social marketing campaigns (Jenks et al 2010). Non-sensitive indicators of peoples' involvement in illicit behaviours may be used to identify particular demographics associated with rule breaking, facilitating the effective targeting of interventions. However, if the group of people under investigation, for example farmers, are diverse with many sub-groups

represented (e.g. many farm types) each sub-group must be sampled adequately for RRT to achieve estimates with acceptable levels of error.

Part Two

Sanctioning wildlife crimes

Incentives appeal to the innate desire that people have to improve themselves by seeking pleasure and avoiding pain; for example government subsidies may provide positive incentives for specific behaviours (e.g. agri-environment schemes), whereas penalties for crimes provide negative incentives aimed at persuading people to comply with regulations (van Vugt 2009). However, sanctions can be counterproductive if they are considered unfair, as such, in addition to reflecting how serious a crime was, sanctions should be socially acceptable, for this reason public and professional opinions on sentencing are often consulted (Roberts et al. 2009; Sentencing Council 2011). In Chapter 5 I used conjoint analysis to investigate which aspect of wildlife trade crimes conservationists, magistrates and the public considered most important when sentencing hypothetical wildlife trade crimes. Whilst most frequently used in marketing to investigate which attributes of a product are most desirable to consumers, I have shown how conjoint analysis can be a useful tool for investigating differences between groups of people, and their perspectives on policy issues such as aspects of crimes and defendants considered at sentencing.

My results suggest that the way in which magistrates assess how serious a wildlife crime was, is in keeping with public opinion towards wildlife crime and that magistrates assess how serious such crimes are in the same manner in which they assess more commonly prosecuted crimes for which sentencing guidelines exist. They place considerable importance upon the illegal profits that wildlife criminals stand to make from their involvement in illicit trading. However, in many countries there has been concern that sanctions for wildlife crimes, including the illegal trade in wildlife and its products, do not reflect how serious wildlife crimes are in terms of the illegal profits to be made or the threat status of species involved (Chaber et al. 2010; Eagle and Betters 1998).That said, wildlife crime in general is under-researched and there is an apparent lack of empirical analysis testing these assumptions. As such in Chapter 6 I reviewed sanctions awarded in the United Kingdom for wildlife crimes prosecuted over a 23 year period. Due to a paucity of data on the black market value of wildlife and wildlife products, it was not possible to investigate the relationship of sanctions with the potential profit to be made from wildlife crimes. However, it was possible to investigate the relationship of sanctions with the protection status

afforded to different species. My results suggest that magistrates and judges consider the protection status of the species involved in wildlife crimes when passing sentences. Harsher sentences were awarded for crimes involving CITES Appendix I species compared to crimes involving CITES Appendix II species, or offences under the Wildlife and Countryside Act. Further, harsher sanctions were awarded for offences under the WCA involving multiple, compared to single specimens, suggesting that magistrates were using their sentencing powers to award sanctions in respect of each single specimen (e.g. bird, nest, or egg) for which an offence has been committed, as if each where a separate crime.

Only by improving our knowledge of criminal sentencing procedures through empirical research may conservationists understand if judiciaries are in need of further information to assist in awarding sanctions which may ultimately deter wildlife crime. Currently it is unclear how frequently magistrates are provided with adequate information concerning illegal profits made from wildlife crimes. The relationship between threat status and sanction severity shown in the data analysed for Chapter 6 of this thesis suggests that information on threat status is reaching the courts. However, these data also suggest that information regarding illegal profits is rarely known. For example only 5.5% (n = 696) of wildlife crime prosecutions analysed for Chapter 6 had financial values associated with them. However, Chapter 6 analysed information on wildlife crime prosecutions as recorded by wildlife NGOs, it did not analyse the *actual* information presented in court, which may differ. In order to improve the degree of understanding as to how frequently magistrates are provided with sufficient information on crime characteristics it would be beneficial to review the contents of a sample of cases as they were presented in court. Completing such a review will clarify the types of wildlife crime characteristics that are generally presented in court and if any characteristics relevant to sentencing are currently omitted. If it becomes evident that courts are rarely presented with sufficient information on which to base their sentencing decisions, which should include consideration of illegal profits, action may be taken to improve the situation. As an initial step the National Wildlife Crime Unit in the United Kingdom could be consulted in order to understand the current state of knowledge with respect to illegal profits made from wildlife crimes.

7.3 Implications for research

This thesis has made some suggestions as to how research into social psychological drivers of human decision making including people's attitudes and how attitudes

relate to behaviour, may be improved making such studies more useful for management purposes (Chapter 2). Using RRT, a method specifically designed for investigating sensitive topics, this thesis has estimated the prevalence of a range of sensitive and illegal behaviours in conservation (Chapters 3 and 4). This thesis has also shown how RRT can be adapted to investigate innocuous indicators of involvement in illegal or otherwise sensitive behaviours (Chapter 4). However, whilst evidence from validation studies suggests that RRT returns more accurate reports of peoples' involvement in sensitive behaviours compared to conventional survey techniques (Tracy and Fox 1981; Lensvelt-Mulders et al. 2005b), underreporting cannot be ruled out. Understanding the level of underreporting (or put another way, *'how close to the truth are RRT estimates?'*), is an interesting area of research still open to investigation.

Validation studies for RRT require information concerning the true status of each individual in respect of a sensitive behaviour, for example police arrest records, and access to each individual. Difficulties associated with accessing such information means that validation studies are rare. However, using common pool resource games (Ostrom et al. 1994) in which players have the chance to make money (e.g. Travers et al. 2011) it may be possible to experimentally create a validation study. For example players, self-reporting their own behaviour thus providing records of true status required of validation studies, may be told that there is a communal resource from which they may all extract. Each player may extract between 0 and *x* units of the resource from the common pool containing 100 units of the resource. For every unit extracted, individual players receive a set price (e.g. £1.00 per unit) and for every unit remaining in the common pool everyone in the group receives a set price (e.g. 10p per unit) representing the value of the resource to future extraction. After playing a number of rounds of such a game an enforcement treatment (whereby players know the probability of being detected if they break rules, and fines are awarded) may be introduced making all extraction illegal (Travers et al. 2011); this creates the opportunity for rule breaking to occur. After participating in the games but prior to receiving payment, players could be asked to report their game-play via RRT. The topic is sensitive because players who broke rules, but where not detected and fined, may perceive that telling the truth holds consequences, revealing their rule breaking could result in their payments being subjected to fines. Players' behaviour as reported via RRT could later be compared to their self-reported game play. Artificially creating such a validation study would require experimentation, with

consideration given to the size of the financial incentive required to induce the necessary rule breaking.

Few studies have used computers to deliver RRT surveys despite evidence to suggest that respondents feel that computers give them extra privacy (Lensvelt and Boeije 2007). Where computer-literacy and access is considered sufficient, online RRT surveys could be a viable method for accessing large numbers of respondents. However, careful piloting would be required to ensure that respondents trust the computerised randomising device and follow survey instructions particularly in the absence of a researcher. If successful, the development of computerised RRT surveys addressing conservation and natural resource management issues could become a cost-effective method for accessing widely dispersed respondents. However, RRT is just one method which addresses the inherent difficulties of asking people sensitive questions and it is currently unknown if over time respondents will become desensitised to the technique if asked to complete multiple surveys applying the method. To this end it is important to continue to learn from other disciplines as there may be other methods which can be adapted to fulfil the needs of research into assessing sensitive behaviours in conservation. One method which holds potential for estimating the prevalence of sensitive behaviours is the unmatched count technique which has been used across a range of sensitive behaviours including rule breaking by auctioneers (Dalton et al. 1994), and anti-gay hate crime (Rayburn et al. 2003). This method requires two groups of respondents: without identifying which behaviours they do, group A report how many of the behaviours presented to them on a list they perform, this list includes one sensitive behaviour; Group B also report how many behaviours on the list that they perform, the list is the same except the sensitive behaviour is omitted. The proportion of people engaged in the sensitive behaviour is the difference in the mean number of behaviours reported by the two groups (Tourangeau and Yan 2007). The implicit association test (IAT) which has been used to investigate people's implicit attitudes towards a number of sensitive behaviours including people's sexual orientation (Banse et al. 2001) and racial prejudice (McConnell and Liebold 2001) offers potential as an indicator of people's involvement in sensitive behaviours. IAT requires respondents to categorise stimuli which appear on a screen as instructed. For example in a study investigating racism Greenwald et al. (1998) instructed participants to categorise a list of names as being typically for black or white people. They were then required to associate a variety of pleasant words (e.g. miracle) with the names of black people, and a variety of unpleasant words (e.g. 'evil') with the names of white people. The tasks are then

reversed. The difference in the time taken to complete these exercises reveals respondents' underlying evaluation of the topic, i.e. their implicit attitudes (Fazio and Olson 2003). Greenwald et al. (1998) reported that respondents were quicker to associate negative words with the names of black people, than they were to associate them with white people, indicating a degree of racism in the study group.

With the exception of one study identified below (Ana Nuno; in prep), these methods do not appear to have been applied to behaviours of interest to conservation and natural resource management. In order to understand if the validity of data obtained from such methods is greater than that obtained from conventional survey instruments used to directly estimate sensitive behaviours, comparative studies (e.g. Chapter 3) are required (Gavin et al. 2010). Further, if indicators such as implicit attitudes (e.g. from IAT studies) are to be suggested as proxy indicators of people's involvement in illicit behaviours, attempts must be made to link indicators to reports of behaviour (perhaps obtained via RRT, or another risk-reducing method) as done in Chapter 4 of this thesis.

As a way forward, a wider body of empirical data from a variety of case studies are needed. To this end efforts are already underway. For example the unmatched count technique is being used to investigate illegal resource extraction from the Serengeti National Park, Tanzania (Ana Nuno; in prep) and illegal behaviours have been incorporated into choice experiments investigating household decision making (Nick Hanley; in prep). With respect to the latter study, it will be interesting to see how effective choice experiments are at elucidating information about house decision making once a sensitive behaviour has been incorporated.

Chapters 5 and 6 of this thesis contribute to the understanding of wildlife crime sanctioning in an established judicial system. I hope that these chapters improve conservationist's appreciation of the multitude of factors considered by judiciaries when assessing how serious a crime was, and deciding upon appropriate sanctions. Setting sentences is not as clear cut as it may seem and the apparently low fines awarded for some wildlife crimes may be the result of factors which must be considered at sentencing (e.g. an offender's ability to pay) rather than evidence that judiciaries do not consider wildlife crimes to be serious offences. Whilst it has been possible to investigate how sanctions relate to the conservation impact of wildlife crimes (Chapter 6), the paucity of reliable data on black market values of wildlife products prevented an analysis of the relationship between sanction severity and

illegal profits. Those who have reported black market values for wildlife products have generally obtained the information through informal discursive discussions with sellers, obtaining prices for a limited number of wildlife products in a variety of countries (e.g. Stiles and Martin 2001; Chaber et al. 2010). Given differences in data collection locations and techniques, including stages in markets that values represent (e.g. middle or end market) using data from published and grey literature may not be considered adequately robust for analysing how sanctions awarded in the United Kingdom relate to potential profits. Given the difficulties associated with obtaining reliable black market values (and the considerable number of species involved) one option could be to request legal sale values from pet traders, falconers, taxidermists, and antiques dealers in the United Kingdom and to conduct an analysis of how sanctions relate to legal values of wildlife products. However, due to its nature, such an analysis would fail to account for inflated prices which may be paid on the black market for rare, highly valued specimens (Angulo et al. 2009).

Wildlife crimes are frequently motivated by the considerable profits that unscrupulous individuals stand to make. Given the gravity that magistrates place on illegal profits when they are assessing crimes (Chapter 5) increased research in this area is urgently required so that judiciaries can be provided with adequate information to assess how serious wildlife crimes are. However, just as positive incentives have been shown to crowd out people's motivations to engage in certain behaviours due to a sense of moral obligation (e.g. donating blood, Titmuss 1979), when negative incentives (e.g. punishing over-use) are perceived as unfair, they too can be counterproductive (e.g. if people perceive they pay dearly for running a car, they are more likely to believe they have the right to use it as much as they like) (van Vugt 2009). What constitutes a fair and adequate sanction that will deter wildlife criminals is another area of research worthy of further investigation.

7.4 Implications for policy

Many approaches to biodiversity conservation depend upon rules which, to differing extents may restrict the spatial and temporal dimensions of resource extraction. For example, across the United Kingdom it is illegal to kill hen harriers (*Circus cyaneus*) throughout the year; whilst in England and Wales a national bylaw prohibits the killing of brown trout (*Salmo trutta*) during a 5.5 month closed season. In many instances quotas determine the level of offtake permitted and, because it is difficult to estimate animal population sizes and monitor changes over time, modelling has made an important contribution to understanding the influences of difference

management regimes on animal populations (Caro et al. 2009). However, in the absence of information on the levels of illegal resource extraction, quotas may be set too high; for extreme cases this could lead to population extinctions. Whilst in some cultures it may be acceptable to divulge sensitive information irrespective of the manner in which it is requested, when investigating sensitive topics it is naive to expect respondents to provide honest answers when asked directly. Methods such as RRT have the potential to assess the extent of peoples' involvement in illegal resource extraction. Such information can be incorporated into modelling approaches investigating the impact of management regimes on animal populations being used to inform resource management decisions and policy. Whilst there is some evidence that RRT can be adapted for use in communities with low literacy (Solomon et al. 2007) a wider variety of case studies are needed in order to establish how broadly RRT may be applied to conservation and natural resource management problems.

In the absence of adequate implementation, including enforcement, regulations are ineffective. The persistence of illegal wildlife trading globally suggests that the effectiveness of national and regional legislations developed to enact CITES are currently limited. Ultimately, as suggested to reduce the illegal exploitation of black rhinos (*Diceros bicornis*) and African elephants (*Loxodonta Africana*) in Luangwa Valley, Zambia (Leader-Williams and Milner-Gulland 1993), reducing wildlife crimes may be most effectively achieved by increasing probabilities of detection rather than simply increasing the severity of sanctions. Indeed, poaching from the Seregeti National Park, Tanzania reduced following increased patrol effort (Hilborn et al. 2006). However, investigating the level of resources that government-led management authorities allocate to enforcement can be difficult as authorities may not wish to reveal such information (indeed, my research permit for Tanzania was turned down because I was interested issues of enforcement). This has real implications for research efforts attempting to understand and inform policy in respect of law enforcement.

Whilst authorities may be encouraged to collaborate with researchers interested in understanding how best to reduce wildlife crime within and across borders, researchers must learn to communicate beyond their disciplines and develop acceptable ways in which such topics may be investigated. Part 2 of this thesis applied a method developed in marketing to investigate sentencing decision of magistrates and together with an analysis of wildlife crime prosecutions held in the United Kingdom an important issue of policy relevance is now supported with

empirical evidence. Results of Chapter 5 provide evidence that magistrates place considerable weight upon the illegal profit made by criminals when making sentencing decisions, yet for wildlife crimes, such information may rarely be made available for consideration in court. As such, when preparing cases for court the Crown Prosecution Service should be encouraged to ensure that such information is available for presentation so that magistrates have appropriate information to assess how serious the wildlife crime was in terms that they can relate to. Further, the Sentencing Guidelines Council for England and Wales currently do not include guidance on how to process wildlife crimes in the Magistrates' Court Sentencing Guidelines (Sentencing Guidelines Council, 2008), the aim of which is to ensure consistency in sentencing across Magistrates' Courts. Given that policy makers do not (or rarely) read papers in peer review journals, the publication of Chapter 5 in Environmental Conservation will not influence the content of the Magistrates' Court Sentencing Guidelines. Instead, such an objective may be achieved through communication with the Crown Prosecution Service, the principal prosecuting authority in England and Wales, and attempts should be made to do so. Whilst a limited number of wildlife crimes may reach Magistrates' Courts each year, they are frequently of a delicate nature due to the high level of public interest they receive, as such providing magistrates with the same degree of guidance that they receive for other more frequently processed crimes seems to be an appropriate recommendation.

7.5 Conclusion

Just as conservationists do not find it acceptable to conduct poorly planned ecological monitoring, it should not be acceptable to conduct poor social science research. Most conservationists trained in the biological sciences, and whilst there is an implicit understanding that the biggest threat to biodiversity and successful conservation is human behaviour, many conservationists lack training in the social sciences (Adams 2007). As few human led drivers of biodiversity loss show signs of slowing in the near future (Ehrlich and Pringle 2008), we must act promptly. To this end an efficient approach would be to learn from other disciplines. Several disciplines offer models of human decision-making, and opportunities to collaborate with researchers from other disciplines including anthropology, economics, social psychology are increasingly available. Expanding our knowledge beyond traditional academic boundaries will enhance our ability to develop a conservation science more attuned to the complex array of factors influencing human decision making at individual and societal levels.

References

Adams, W.M., 2007. Thinking like a human: social science and the two cultures problem. Oryx 41, 275-276.

Agarwala, M., Kumar, S., Treves, A., Naughton-Treves, L., 2010. Paying for wolves in Solapur, India and Wisconsin, USA: comparing compensation rules and practice to understand the goals and politics of wolf conservation. Biological Conservation 143, 2945-2955.

Agnew, D.J., Pearce, J., Pramod, G., Peatman, T., Watson, R., Beddington, J.R., Pitcher, T.J., 2009. Estimating the worldwide extent of illegal fishing. PLoS ONE 4, e4570.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: the role of community in natural resource conservation. World Development 27, 629-649.

Aipanjiguly, S., Jacobson, S.K., Flamm, R., 2003. Conserving manatees: knowledge, attitudes, and intentions of boaters in Tampa Bay, Florida. Conservation Biology 17, 1098-1105.

Ajzen, I., 1991. The theory of planned behavior. Organizational Behavior and Human Decision Processes 50, 179-211.

Ajzen, I., 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. Journal of Applied Social Psychology 32, 665-683.

Ajzen, I., Fishbein, M., 1980. Understanding attitudes and predicting social behaviour. Prentice-Hall, Englewood Cliffs, New Jersey 07632.

Ajzen, I., Madden, T.J., 1986. Prediction of goal-directed behavior: attitudes, intentions, and perceived behavioral control. Journal of Experimental Social Psychology 22, 453-474.

Alacs, E., Georges, A., 2008. Wildlife across our borders: a review of the illegal trade in Australia. Australian Journal of Forensic Sciences 40, 147-160.

Albarracín, D., Johnson, B.T., Fishbein, M., Muellerleile, P.A., 2001. Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. Psychological Bulletin 127, 142-161.

Albarracín, D., Johnson, B.T., Zanna, M.P., Kumkale, T.G., 2005. Attitudes: Introduction and scope, In The Handbook of Attitudes. eds Dolores Albarracín, Blair T. Johnson, Mark P. Zanna, pp. 3-20. Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey.

Álvarez-Farizo, B., Hanley, N., 2002. Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain. Energy Policy 30, 107-116.

Angulo, E., Deves, A.-L., Saint Jalmes, M., Courchamp, F., 2009. Fatal attraction: rare species in the spotlight. Proceedings of the Royal Society B: Biological Sciences 276, 1331-1337.

Anoliefo, G.O., Isikhuemhen, O.S., Ochije, N.R., 2003. Environmental implications of the erosion of cultural taboo practices in Awka-South local government area of Anambra State, Nigeria: 1. forests, trees, and water resource preservation. Journal of Agricultural and Environmental Ethics 16, 281-296.

Arjunan, M., Holmes, C., Puyravaud, J.-P., Davidar, P., 2006. Do developmental initiatives influence local attitudes toward conservation? A case study from the Kalakad-Mundanthurai Tiger Reserve, India. Journal of Environmental Management 79, 188-197.

Armitage, C.J., Conner, M., Loach, J., Willetts, D., 1999. Different perceptions of control: applying an extended theory of planned behavior to legal and illegal drug use. Basic and Applied Social Psychology 21, 301 - 316.

Bagchi, S., Mishra, C., 2006. Living with large carnivores: predation on livestock by the snow leopard *(Uncia uncia)*. Journal of Zoology 268, 217-224.

Bamberg, S., Möser, G., 2007. Twenty years after Hines, Hungerford, and Tomera: a new meta-analysis of psycho-social determinants of pro-environmental behaviour. Journal of Environmental Psychology 27, 14-25.

Banse, R., Seise, J., Zerbes, N., 2001. Implicit attitudes toward homosexuality: reliability, validity, and controllability of the IAT. Experimental Psychology 48, 145-160.

Barrett, C., B., Arcese, P., 1995. Are Integrated Conservation-Development Projects (ICDPs) sustainable? On the conservation of large mammals in sub-Saharan Africa. World Development 23, 1073-1084.

Beck, L., Ajzen, I., 1991. Predicting dishonest actions using the theory of planned behavior. Journal of Research in Personality 25, 285-301.

Becker, G.S., 1968. Crime and punishment: an economic approach. The Journal of Political Economy 76, 169-217.

Beedell, J., Rehman, T., 2000. Using social-psychology models to understand farmers' conservation behaviour. Journal of Rural Studies 16, 117-127.

Berkes, F., Colding, J., Folke, C., 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10, 1251-1262.

Berkes, F., Hughes, T.P., Steneck, R.S., Wilson, J.A., Bellwood, D.R., Crona, B., Folke, C., Gunderson, L.H., Leslie, H.M., Norberg, J., Nystrom, M., Olsson, P., Osterblom, H., Scheffer, M., Worm, B., 2006. Globalization, roving bandits, and marine resources. Science 311, 1557-1558.

Bjørklund, I., 1990. Sámi reindeer pastoralism as an indigenous resource management system in northern Norway: a contribution to the common property debate. Development and Change 21, 76-86.

Blackburn, T.M., Cassey, P., Duncan, R.P., Evans, K.L., Gaston, K.J., 2004. Avian extinction and mammalian introductions on oceanic islands. Science 305, 1955-1958.

Blank, S.G., Gavin, M.C., 2009. The randomized response technique as a tool for estimating non-compliance rates in fisheries: a case study of illegal red abalone (*Haliotis rufescens*) fishing in Northern California. Environmental Conservation 36, 112-119.

Blume, L.E., Easley, D., 2008. Rationality, In The New Palgrave Dictionary of Economics. Palgrave Macmillan, Basingstoke.

Blundell, A.G., Mascia, M.B., 2005. Discrepancies in reported levels of international wildlife trade. Conservation Biology 19, 2020-2025.

Bockenholt, U., van der Heijden, P.G.M., 2007. Item randomized-response models for measuring noncompliance: risk-return perceptions, social influences, and self-protective responses. Psychometrika 72, 245-262.

Bodin, O., Tengo, M., Norman, A., Lundberg, J., Elmqvist, T., 2006. The value of small size: loss of forest patches and ecological thresholds in Southern Madagascar. Ecological Applications 16, 440-451.

Bolker, B.M., Brooks, M.E., Clark, C.J., Geange, S.W., Poulsen, J.R., Stevens, M.H.H., White, J.-S.S., 2009. Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology & Evolution 24, 127-135.

Bradshaw, C.J.A., Sodhi, N.S., Brook, B.W., 2009. Tropical turmoil: a biodiversity tragedy in progress. Frontiers in Ecology and the Environment 7, 79-87.

Breslow, N.E., 2003. Whither PQL?, In UW Biostatistics Working Paper Series. The Berkeley Electronic Press (bepress). University of Washington, Washington.

Breslow, N.E., Clayton, D.G., 1993. Approximate inference in generalized linear mixed models. Journal of the American Statistical Association 88, 9-25.

Brocke, M., Göldenitz, C., Holling, H., Bilsky, W., 2004. Attitudes towards severity of punishment: a conjoint analytic approach. Psychology, Crime & Law 10, 205 - 219.

Brooks, T.M., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Rylands, A.B., Konstant, W.R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G., Hilton-Taylor, C., 2002. Habitat loss and extinction in the hotspots of biodiversity. Conservation Biology 16, 909-923.

Bulte, E.H., Horan, R.D., 2003. Habitat conservation, wildlife extraction and agricultural expansion. Journal of Environmental Economics and Management 45, 109-127.

Burnham, K.P., Anderson, D.R., 2002. Model Selection and Multimodel Inference: a practical information-theoretic approach, 2nd edn. Springer-Science+Business Media, Inc., New York.

Caro, T. M., Young, C. R., Cauldwell, A. E. & Brown, D. D. E. 2009. Animal breeding systems and big game hunting: models and application. Biological Conservation 142, 909-929.

Carpenter, K.E., Abrar, M., Aeby, G., Aronson, R.B., Banks, S., Bruckner, A., Chiriboga, A., Cortes, J., Delbeek, J.C., DeVantier, L., Edgar, G.J., Edwards, A.J., Fenner, D., Guzman, H.M., Hoeksema, B.W., Hodgson, G., Johan, O., Licuanan, W.Y., Livingstone, S.R., Lovell, E.R., Moore, J.A., Obura, D.O., Ochavillo, D., Polidoro, B.A., Precht, W.F., Quibilan, M.C., Reboton, C., Richards, Z.T., Rogers, A.D., Sanciangco, J., Sheppard, A., Sheppard, C., Smith, J., Stuart, S., Turak, E., Veron, J.E.N., Wallace, C., Weil, E., Wood, E., 2008. One-third of reef-building corals face elevated extinction risk from climate change and local impacts. Science 321, 560-563.

Cavalcanti, S. M. C., Marchini, S., Zimmermann, A., Gese, E. M. & Macdonald, D. W. 2010. Jaguars, livestock and people in Brazil: realities and perceptions behind the conflict. In: The biology and conservation of wild felids, eds. D. Macdonald & A. Loveridge, pp. 383-402. Oxford University Press, Oxford, United Kingdom.

Chaber, A.-L., Allebone-Webb, S., Lignereux, Y., Cunningham, A.A., Marcus Rowcliffe, J., 2010. The scale of illegal meat importation from Africa to Europe via Paris. Conservation Letters 3, 317-321.

Chaloupka, M.Y., 1985. Application of the randomized response technique to marine park management: an assessment of permit compliance. Environmental Management 9, 393-398.

Chape, S., Harrison, J., Spalding, M., Lysenko, I., 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. Philosophical Transactions of the Royal Society B: Biological Sciences 360, 443-455.

Chen, X., Lupi, F., He, G., Liu, J., 2009. Linking social norms to efficient conservation investment in payments for ecosystem services. Proceedings of the National Academy of Sciences 106, 11812-11817.

Cialdini, R.B., Reno, R.R., Kallgren, C.A., 1990. A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. Journal of Personality and Social Psychology 58, 1015-1026.

Cialdini, R.B., Trost, M.T., 1998. Social influence: social norms, conformity and compliance, In The handbook of social psychology. Fourth edition. eds Daniel T. Gilbert, Susan T. Fiske, Lindzey Gardner pp. 151-192. McGraw-Hill, New York.

CITES, 2011. Convention on International Trade in Endangered Species of Wild Fauna and Flora. What is CITES? [www document]. URL http://www.cites.org/eng/disc/what.shtml. Accessed 04 May 2011.

Clark, C.W., 1973. The economics of overexploitation. Science 181, 630-634.

Clavero, M., García-Berthou, E., 2005. Invasive species are a leading cause of animal extinctions. Trends in Ecology & Evolution 20, 110-110.

Colding, J., Folke, C., 1997. The relations among threatened species, their protection, and taboos. Conservation Ecology [online] 1 (1): 6, URL: http://www.consecol.org/vol1/iss1/art6/.

Colding, J., Folke, C., 2001. Social taboos: 'invisible' systems of local resource management and biological conservation. Ecological Applications 11, 584-600.

Conner, M., Armitage, C.J., 1998. Extending the theory of planned behavior: a review and avenues for further research. Journal of Applied Social Psychology 28, 1429-1464.

Conner, M., McMillan, B., 1999. Interaction effects in the theory of planned behaviour: studying cannabis use British Journal of Social Psychology 38, 195-222.

Conner, M., Sparks, P., 2008. Theory of planned behaviour, In Predicting Health Behaviour. eds M. Conner, P. Norman, pp. 170 - 222. Open University Press, Maidenhead.

Cook, D., Roberts, M., Lowther, J., 2002. The international wildlife trade and organised crime. A review of the evidence and the role of the UK, p. 34. Regional Research Institute, University of Wolverhampton, Wolverhampton, UK.

Cross, P., Williams, P., Edwards-Jones, G., 2009. Differences in the perceptions of farmers and veterinary surgeons about the efficacy of mitigation strategies for controlling bluetongue. Veterinary Record 165, 397-403.

Crutzen, P.J., 2002. The "Anthropocene". Journal Physique IV France 12, 1-5.

Dalton, D.R., Wimbush, J.C., Daily, C.M., 1994. Using the unmatched count technique (UCT) to estimate base rates for sensitive behavior. Personnel Psychology 47, 817-829.

Damania, R., Milner-Gulland, E.J., Crookes, D.J., 2005. A bioeconomic analysis of bushmeat hunting. Proceedings of the Royal Society B: Biological Sciences 272, 259-266.

de Boer, W.F., Baquete, D.S., 1998. Natural resource use, crop damage and attitudes of rural people in the vicinity of the Maputo Elephant Reserve, Mozambique. Environmental Conservation 25, 208-218.

Department of Environmental Affairs and Tourism, 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Threatened or Protected Species Regulations. The Government Printing Works, Pretoria, Republic of South Africa.

Donovan, J.J., Dwight, S.A., Hurtz, G.M., 2003. An assessment of the prevalence, severity, and verifiability of entry-level applicant faking using the randomized response technique Human Performance 16, 81-106.

Durham, A.M., 1993. Public opinion regarding sentences for crime: does it exist? Journal of Criminal Justice 21, 1-11.

Eagle, J.G., Betters, D.R., 1998. The endangered species act and economic values: a comparison of fines and contingent valuation studies. Ecological Economics 26, 165-171.

Edwards-Jones, G., 2006. Modelling farmer decision-making: concepts, progress and challenges. Animal Science 82, 783-790.

Ehrlich, P.R., Pringle, R.M., 2008. Where does biodiversity go from here? A grim business-as-usual forecast and a hopeful portfolio of partial solutions. Proceedings of the National Academy of Sciences 105, 11579-11586.

Emerton, L., 1999. Community-based incentives for nature, p. 46. IUCN, Gland, Switzerland and Cambridge, UK.

Fazio, R.H., Olson, M.A., 2003. Implicit measures in social cognition research: their meaning and use. Annual Review of Psychology 54, 297-327.

Fernandez-Gimenez, M.E., 2000. The role of Mongolian nomadic pastoralists' ecological knowledge in rangeland management. Ecological Applications 10, 1318-1326.

Fiallo, E.A., Jacobson, S.K., 1995. Local communities and protected areas: attitudes of rural residents towards conservation and Machalilla National Park, Ecuador. Environmental Conservation 22, 241-249.

Fishbein, M., Ajzen, I., 1975. Belief, Attitude, Intention and Behaviour: an Introduction to Theory and Research. Addison-Wesley Publishing Company, Reading, Massachusetts.

Fisher, R.J., 1993. Social desirability bias and the validity of indirect questioning. The Journal of Consumer Research 20, 303-315.

Fitzgerald, T., 2002. Public opinion sampling. Society 39, 53-59.

Freud, 1950. Totem and Taboo. Routledge and Kegan Paul Ltd, London.

Friedmann, Y., Daly, B., Keith, M., Peddemors, V., Chimimba, C., Byers, O., 2002. Conservation Assessment and Management Plan for the Mammals of South Africa. Conservation Africa / Endangered Wildlife Trust. Conservation Breeding Specialist Group (SSC / IUCN), Apple Valley, MN, USA.

Gadgil, M., Vartak, V.D., 1976. The sacred groves of Western Ghats in India. Economic Botany 30, 152-160.

Gaveau, D.L.A., Linkie, M., Suyadi, Levang, P., Leader-Williams, N., 2009. Three decades of deforestation in southwest Sumatra: effects of coffee prices, law enforcement and rural poverty. Biological Conservation 142, 597-605.

Gavin, M., Solomon, J., Blank, S.G., 2010. Measuring and monitoring the illegal use of natural resources. Conservation Biology 24, 89-100.

Gelcich, S., Edwards-Jones, G., Kaiser, M., Castilla, J., 2006. Co-management policy can reduce resilience in traditionally managed marine ecosystems. Ecosystems 9, 951-966.

Gelcich, S., Edwards-Jones, G., Kaiser, M.J., Watson, E., 2005. Using discourses for policy evaluation: the case of marine common property rights in Chile. Society & Natural Resources 18, 377 - 391.

Gelman, A., Hill, J., 2007. Data Analysis Using Regression and Multilevel / Hierarchical Models, 1st edition edn. Cambridge University Press, New York, USA.

Gordon, R., McDermott, L., Stead, M., Angus, K., 2006. The effectiveness of social marketing interventions for health improvement: What's the evidence? Public Health 120, 1133-1139.

Graham, K., Beckerman, A.P., Thirgood, S., 2005. Human-predator-prey conflicts: ecological correlates, prey losses and patterns of management. Biological Conservation 122, 159-171.

Green, P.E., Rao, V.R., 1971. Conjoint measurement for quantifying judgmental data. Journal of Marketing Research 8, 355-363.

Greenwald, A.G., McGhee, D.E., Schwartz, J.L.K., 1998. Measuring individual differences in implicit cognition: the implicit association test. Journal of Personality and Social Psychology 76, 1464-1480.

Hanley, N., MacMillan, D., Patterson, I., Wright, R.E., 2003. Economics and the design of nature conservation policy: a case study of wild goose conservation in Scotland using choice experiments. Animal Conservation 6, 123-129.

Hardeman, W., Johnston, M., Johnston, D.W., Bonetti, D., Wareham, N.J., Kinmonth, A.L., 2002. Application of the theory of planned behaviour in behaviour change interventions: a systematic review. Psychology and Health 17, 123-158.

Hardin, G., 1968. The tradegy of the commons. Science 162, 1243-1248.

Harkes, I., Novaczek, I., 2002. Presence, performance, and institutional resilience of sasi, a traditional management institution in Central Maluku, Indonesia. Ocean & Coastal Management 45, 237-260.

Hedmark, E., Ellegren, H., 2005. Microsatellite genotyping of DNA isolated from claws left on tanned carnivore hides. International Journal of Legal Medicine 119, 370-373.

Hilborn, R., 2007. Managing fisheries is managing people: what has been learned? Fish and Fisheries 8, 285-296.

Hilborn, R., Arcese, P., Borner, M., Hando, J., Hopcraft, G., Loibooki, M., Mduma, S., Sinclair, A.R.E., 2006. Effective enforcement in a conservation area. Science 314, 1266.

Holmes, C.M., 2003. The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. Oryx 37, 305-315.

Home, R., Keller, C., Nagel, P., Bauer, N., Hunziker, M., 2009. Selection criteria for flagship species by conservation organizations. Environmental Conservation 36, 139-148.

Hounsome, B., Edwards, R.T., Edwards-Jones, G., 2006. A note on the effect of farmer mental health on adoption: The case of agri-environment schemes. Agricultural Systems 91, 229-241.

House of Commons, 2004. Environmental Crime: Wildlife crime. Twelfth Report of Session 2003–04, p. 39. Environmental Audit Committee. The Stationery Office Limited, London.

Hox, J., Lensvelt-Mulders, G., 2004. Randomized response analysis in M*plus*. Structural Equation Modeling 11, 615-620.

Infield, M., Namara, A., 2001. Community attitudes and behaviour towards conservation: an assessment of a community conservation programme around Lake Mburo National Park, Uganda. Oryx 35, 48-60.

Inskip, C., Zimmermann, A., 2009. Human-felid conflict: a review of patterns and priorities worldwide. Oryx 43, 18-34.

IUCN, 2010. IUCN Red List of Threatened Species. Version 2010.4. [www document]. URL http://www.iucnredlist.org/. Accessed 10 January 2011.

Jachmann, H., 2008. Illegal wildlife use and protected area management in Ghana. Biological Conservation 141, 1906-1918.

James, A.N., Gaston, K.J., Balmford, A., 1999. Balancing the Earth's accounts. Nature 401, 323-324.

Jenks, B., Vaughan, P.W., Butler, P.J., 2010. The evolution of Rare Pride: using evaluation to drive adaptive management in a biodiversity conservation organization. Evaluation and Program Planning 33, 186-190.

Jepson, P., Jarvie, J.K., MacKinnon, K., Monk, K.A., 2001. The end for Indonesia's lowland forests? Science 292, 859-861.

JNCC, 2010. Joint Nature Conservation Committee. UK Biodiversity Action Plan: organisations. [www document]. URL http://www.ukbap.org.uk/orgs. Accessed 24 August 2010.

Johannes, R.E., 1982. Traditional conservation methods and protected marine areas in Oceania. Ambio 11, 258-261.

Johnson, R., 2010. The use of DNA identification in prosecuting wildlife-traffickers in Australia: do the penalties fit the crimes? Forensic Science, Medicine, and Pathology 6, 211-216.

Jones, J.P.G., Andriamarovololona, M.M., Hockley, N., 2008a. The importance of taboos and social norms to conservation in Madagascar. Conservation Biology 22, 976-986.

Jones, J.P.G., Andriamarovololona, M.M., Hockley, N., Gibbons, J.M., Milner-Gulland, E.J., 2008b. Testing the use of interviews as a tool for monitoring trends in the harvesting of wild species. Journal of Applied Ecology 45, 1205-1212.

Just, R.E., Zilberman, D., 1983. Stochastic structure, farm size and technology adoption in developing agriculture. Oxford Economic Papers 35, 307-328.

Karanth, K.K., Nichols, J.D., Karanth, K.U., Hines, J.E., Christensen, N.L., 2010. The shrinking ark: patterns of large mammal extinctions in India. Proceedings of the Royal Society B: Biological Sciences 277, 1971-1979.

Keane, A., Jones, J.P.G., Edwards-Jones, G., Milner-Gulland, E.J., 2008. The sleeping policeman: understanding issues of enforcement and compliance in conservation. Animal Conservation 11, 75-82.

Kideghesho, J.R., 2008. Co-existence between the traditional societies and wildlife in western Serengeti, Tanzania: its relevancy in contemporary wildlife conservation efforts. Biodiversity and Conservation 17, 1861-1881.

King, M.F., Bruner, G.C., 2000. Social desirability bias: A neglected aspect of validity testing. Psychology and Marketing 17, 79-103.

Kuemmerle, T., Hostert, P., Radeloff, V.C., Perzanowski, K., Kruhlov, I., 2007. Post-socialist forest disturbance in the Carpathian border region of Poland, Slovakia, and Ukraine. Ecological Applications 17, 1279-1295.

Lagendijk, D., Gusset, M., 2008. Human–carnivore coexistence on communal land bordering the Greater Kruger Area, South Africa. Environmental Management 42, 971-976.

Lahaut, V.M.H.C.J., Jansen, H.A.M., van de Mheen, D., Garretsen, H.F.L., 2002. Non-response bias in a sample survey on alcohol consumption. Alcohol Alcohol. 37, 256-260.

Lam, S.-P., 1999. Predicting intentions to conserve water from the theory of planned behavior, perceived moral obligation, and perceived water right. Journal of Applied Social Psychology 29, 1058-1071.

Landsheer, J., Van Der Heijden, P., Van Gils, G., 1999. Trust and understanding, two psychological aspects of randomized response. Quality & Quantity 33, 1-12.

Laurance, W.F., Albernaz, A.K.M., Costa, C.D., 2001. Is deforestation accelerating in the Brazilian Amazon? Environmental Conservation 28, 305-311.

Laurance, W.F., Albernaz, A.K.M., Fearnside, P.M., Vasconcelos, H.L., Ferreira, L.V., 2004. Deforestation in Amazonia. Science 304, 1109.

Leader-Williams, N., Milner-Gulland, E.J., 1993. Policies for the enforcement of wildlife laws: the balance between detection and penalties in Luangwa Valley, Zambia. Conservation Biology 7, 611-617.

Lee, R.J., Gorog, A.J., Dwiyahreni, A., Siwu, S., Riley, J., Alexander, H., Paoli, G.D., Ramono, W., 2005. Wildlife trade and implications for law enforcement in Indonesia: a case study from North Sulawesi. Biological Conservation 123, 477-488.

Lee, R.M., 1993. Doing Research on Sensitive Topics. SAGE Publications Ltd., London.

Lensvelt-Mulders, G.J.L.M., Boeije, H.R., 2007. Evaluating compliance with a computer assisted randomized response technique: a qualitative study into the origins of lying and cheating. Computers in Human Behavior 23, 591-608.

Lensvelt-Mulders, G.J.L.M., Hox, J.J., van der Heijden, P.G.M., 2005a. How to improve the efficiency of randomised response designs. Quality & Quantity 39, 253-265.

Lensvelt-Mulders, G.J.L.M., Hox, J.J., van der Heijden, P.G.M., Maas, C.J.M., 2005b. Meta-analysis of randomized response research: Thirty-five years of validation. Sociological Methods Research 33, 319-348.

Lewis, D.M., Phiri, A., 1998. Wildlife snaring - an indicator of community response to a community-based conservation project. Oryx 32, 111-121.

Lindsey, P.A., du Toit, J.T., Mills, M.G.L., 2005. Attitudes of ranchers towards African wild dogs *Lycaon pictus*: Conservation implications on private land. Biological Conservation 125, 113-121.

Linkie, M., Martyr, D.J., Holden, J., Yanuar, A., Hartana, A.T., Sugardjito, J., Leader-Williams, N., 2003. Habitat destruction and poaching threaten the Sumatran tiger in Kerinci Seblat National Park, Sumatra. Oryx 37, 41-48.

Loibooki, M., Hofer, H., Campbell, K.L.I., East, M.L., 2002. Bushmeat hunting by communities adjacent to the Serengeti National Park, Tanzania: the importance of livestock ownership and alternative sources of protein and income. Environmental Conservation 29, 391-398.

Magistrates' Association, 2009. Costing the Earth, guidance for sentencers, p. 127. The Magistrates' Association, London, UK.

Mann, B.Q., 1995. Quantification of illicit fish harvesting in the Lake St Lucia Game Reserve, South Africa. Biological Conservation 74, 107-113.

Manstead, A., S., R., Parker, D., 1995. Evaluating and extending the theory of planned behaviour. European Review of Social Psychology 6, 69 - 95.

Manstead, A.S.R., 2000. The role of moral norm in the attitude-behavior relationship, In Attitudes, behavior, and social context: the role of norms and group membership. eds D.J. Terry, M.A. Hogg, pp. 11-30. Lawrence Erlbaum Associates, Mahwah, NJ.

Mascia, M.B.J., Brosius, P., Dobson, T.A., Forbes, B.C., Horowitz, L., McKean, M.A., Turner, N.J., 2003. Conservation and the social sciences. Conservation Biology 17, 649-650.

May, R.M., Beddington, J.R., Clark, C.W., Holt, S.J., Laws, R.M., 1979. Management of multispecies fisheries. Science 205, 267-277.

McCluskey, S.M., Lewison, R.L., 2008. Quantifying fishing effort: a synthesis of current methods and their applications. Fish and Fisheries 9, 188-200.

McConnell, A.R., Liebold, J.M., 2001. Relations between the implicit association test, explicit racial attitudes, and discriminatory behavior. Journal of Experimental Social Psychology 37, 435-442.

Mehta, J.N., Heinen, J.T., 2001. Does community-based conservation shape favorable attitudes among locals? An empirical study from Nepal. Environmental Management 28, 165-177.

Mesterton-Gibbons, M., Milner-Gulland, E.J., 1998. On the strategic stability of monitoring: implications for cooperative wildlife programmes in Africa. Proceedings of the Royal Society B: Biological Sciences 265, 1237-1244.

Miller, J.D., 1985. The nominative technique: A new method of estimating heroin prevalence, In Self-report methods of estimating drug use: meeting current challenges to validity. eds B.A. Rouse, N.J. Kozel, L.G. Richards. Department of Health and Human Services Publication No. (ADM) 85-1402. Washington, DC: U.S. Government Printing Office.

Mills, M.G.L., Hofer H. (compilers), 1998. Hyaenas: Status Survey and Action Plan. IUCN / SSC Hyaena Specialist Group, p. vi + 154, IUCN Gland, Switzerland, and Cambridge, UK.

Milner-Gulland, E.J., Leader-Williams, N., 1992. A model of incentives for the illegal exploitation of black rhinos and elephants: poaching pays in Luangwa Valley, Zambia. Journal of Applied Ecology 29, 388-401.

Milner-Gulland, E.J., Rowcliffe, J.M., 2007. Conservation and sustainable use: a handbook of techniques. Oxford University Press, Oxford.

Mishra, C., Fitzherbert, A., 2004. War and wildlife: a post-conflict assessment of Afghanistan's Wakhan Corridor. Oryx 38, 102-105.

Monin, B., Norton, M.I., 2003. Perceptions of a fluid consensus: uniqueness bias, false consensus, false polarization, and pluralistic ignorance in a water conservation crisis. Personality and Social Psychology Bulletin 29, 559-567.

Naughton-Treves, L., Grossberg, R., Treves, A., 2003. Paying for tolerance: rural citizens' attitudes toward wolf depredation and compensation. Conservation Biology 17, 1500-1511.

Ndibalema, V.G., Songorwa, A.N., 2008. Illegal meat hunting in serengeti: dynamics in consumption and preferences. African Journal of Ecology 46, 311-319.

Nepal, S., Weber, K., 1995. The quandary of local people - park relations in Nepal's Royal Chitwan National Park. Environmental Management 19, 853-866.

Nilsen, E.B., Milner-Gulland, E.J., Schofield, L., Mysterud, A., Stenseth, N.C., Coulson, T., 2007. Wolf reintroduction to Scotland: public attitudes and consequences for red deer management. Proceedings of the Royal Society B: Biological Sciences 274, 995-1003.

North, D.C., 1994. Economic performance through time. The American Economic Review 84, 359-368.

Noss, A.J., 1998. Cable snares and bushmeat markets in a central African forest. Environmental Conservation 25, 228-233.

Nowell, K., Jackson P. (compilers), 1996. Wild Cats: Status Survey and Action Plans, p. xxiv + 383. IUCN / SSC Cat Specialist Group, Gland, Switzerland.

Office for National Statistics, 2008. 2001 Census. [www document]. URL http://www.ons.gov.uk/ons/guide-method/census/census-2001/index.html. Accessed 27 June 2011.

Office for National Statistics, 2011. All Items Retail Prices Index (RPI): Table (RP02). [www document]. URL http://www.statistics.gov.uk/. Accessed 17 June 2011.

Oli, M.K., Taylor, I.R., Rogers, M.E., 1994. Snow leopard (*Panthera uncia*) predation of livestock: an assessment of local perceptions in the Annapurna Conservation Area, Nepal. Biological Conservation 68, 63-68.

Olupot, W., Barigyira, R., Chapman, C.A., 2009. The status of anthropogenic threat at the people-park interface of Bwindi Impenetrable National Park, Uganda. Environmental Conservation 36, 41-50.

Orme, B., 2006. Getting Started with Conjoint Analysis. Strategies for Product Design and Pricing Research. Research Publishers, Madison, Wisconsin, USA.

Ostapczuk, M., Moshagen, M., Zhao, Z., Musch, J., 2009. Assessing sensitive attributes using the randomized response technique: evidence for the importance of response symmetry. Journal of Educational and Behavioral Statistics 34, 267-287.

Ostrom, E., 2000. Collective action and the evolution of social norms. The Journal of Economic Perspectives 14, 137-158.

Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D., 1999. Revisiting the commons: local lessons, global challenges. Science 284, 278-282.

Ostrom, E., Gardener, R., Walker, J., 1994. Rules, games, and common-pool resources. The University of Michigan Press, Michigan.

Parker, D., 2002. Changing driver's attitudes to speeding: using the theory of planned behaviour, In Changing health behaviour: intervention and research with social cognition models. eds D. Rutter, L. Quine, pp. 138-152. Open University Press, Buckingham.

Parker, D., Stradling, S.G., Manstead, A.S.R., 1996. Modifying beliefs and attitudes to exceeding the speed limit: an intervention study based on the theory of planned behavior. Journal of Applied Social Psychology 26, 1-19.

Parmesan, C., 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution, and Systematics 37, 637-669.

Peres, C.A., Barlow, J., Laurance, W.F., 2006. Detecting anthropogenic disturbance in tropical forests. Trends in Ecology & Evolution 21, 227-229.

Persky, J., 1995. Retrospectives: the ethology of *Homo economicus*. The Journal of Economic Perspectives 9, 221-231.

Petroczi, A., Mazanov, J., Nepusz, T., Backhouse, S., Naughton, D., 2008. Comfort in big numbers: Does over-estimation of doping prevalence in others indicate self-involvement? Journal of Occupational Medicine and Toxicology 3, 19.

Phelps, J., Webb, E.L., Bickford, D., Nijman, V. & Sodhi, N.S. (2010) Boosting CITES. Science 330: 1752–1753.

Plumptre, A.J., Bizumuremyi, J.-B., Uwimana, F., Ndaruhebeye, J.-D., 1997. The effects of the Rwandan civil war on poaching of ungulates in the Parc National des Volcans. Oryx 31, 265-273.

Posner, R.A., Rasmusen, E.B., 1999. Creating and enforcing norms, with special reference to sanctions. International Review of Law and Economics 19, 369-382.

R Development Core Team, 2010. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. Vienna, Austria.

Rae, A.N., 1971. Stochastic programming, utility, and sequential decision problems in farm management. American Journal of Agricultural Economics 53, 448-460.

Raine, J.W., Dunstan, E., 2009. How well do sentencing guidelines work? Equity, proportionality and consistency in the determination of fine levels in the Magistrates' Courts of England and Wales. The Howard Journal of Criminal Justice 48, 13-36.

Rayburn, N.R., Earleywine, M., Davison, G.C., 2003. An investigation of base rates of anti-gay hate crimes using the unmatched-count technique. Journal of Aggression, Maltreatment & Trauma 6, 137-152.

Redpath, S.M., Arroyo, B.E., Leckie, F.M., Bacon, P., Bayfield, N., Gutiérrez, R.J., Thirgood, S.J., 2004. Using decision modeling with stakeholders to reduce human–wildlife conflict: a raptor–grouse case study. Conservation Biology 18, 350-359.

Rivis, A., Sheeran, P., 2003. Descriptive norms as an additional predictor in the theory of planned behaviour: A meta-analysis. Current Psychology 22, 218-233.

Roberts, J.V., Hough, M., Jacobson, J., Moon, N., 2009. Public attitudes to sentencing: an empirical analysis. Criminal Law Review 11, 771-782.

Robinson, E.J.Z., Kumar, A.M., Albers, H.J., 2010. Protecting developing countries' forests: enforcement in theory and practice. Journal of Natural Resources Policy Research 2, 25-38.

Ross, L., Greene, D., House, P., 1977. "The false consensu effect": An egocentric bias in social perception and attribution processes. Journal of Experimental Social Psychology 13, 279-301.

Rosser, A.M., Mainka, S.A., 2002. Overexploitation and species extinctions. Conservation Biology 16, 584-586.

Rounsevell, M.D.A., Annetts, J.E., Audsley, E., Mayr, T., Reginster, I., 2003. Modelling the spatial distribution of agricultural land use at the regional scale. Agriculture, Ecosystems & Environment 95, 465-479.

Rowcliffe, J.M., de Merode, E., Cowlishaw, G., 2004. Do wildlife laws work? species protection and the application of a prey choice model to poaching decisions. Proceedings of the Royal Society B: Biological Sciences 271, 2631-2636.

RSPB, 2011. Wild birds and the law: Report a wildlife crime. [www document]. URL http://www.rspb.org.uk/ourwork/policy/wildbirdslaw/report.aspx. Accessed 11 August 2011.

Ryan, M., Farrar, S., 2000. Using conjoint analysis to elicit preferences for health care. British Medical Journal 320, 1530-1533.

Salafsky, N., Cauley, H., Balachander, G., Cordes, B., Parks, J., Margoluis, C., Bhatt, S., Encarnacion, C., Russell, D., Margoluis, R., 2001. A systematic test of an enterprise strategy for community-based biodiversity conservation. Conservation Biology 15, 1585-1595.

Santos, J.R.A., 1999. Cronbach's alpha: a tool for assessing the reliability of scales. Journal of Extension 37.

Sawtooth Software Inc, 1997. Sawtooth Technical Paper Series: Conjoint Value Analysis (CVA). Version 3.0. Sequim, Washington, USA.

Sawtooth Software Inc., 2002. Sawtooth Technical Paper Series: CVA/HB Technical Paper. Sequim, Washington, USA.

Sawtooth Software Inc., 2010. SSI Web 7. Version 7.0.10. Sawtooth Software Inc. Sequim, Washington, USA.

Scheers, N.J., Dayton, M.C., 1987. Improved estimation of academic cheating behavior using the randomized response technique Research in Higher Education 26, 61-69.

Schill, D.I., Kline, P.A., 1995. Use of random response to estimate angler noncompliance with fishing regulations. North American Journal of Fisheries Management 15, 721-731.

Schipper, J., Chanson, J.S., Chiozza, F., Cox, N.A., Hoffmann, M., Katariya, V., Lamoreux, J., Rodrigues, A.S.L., Stuart, S.N., Temple, H.J., Baillie, J., Boitani, L., Lacher, T.E., Jr., Mittermeier, R.A., Smith, A.T., Absolon, D., Aguiar, J.M., Amori, G., Bakkour, N., Baldi, R., Berridge, R.J., Bielby, J., Black, P.A., Blanc, J.J., Brooks, T.M., Burton, J.A., Butynski, T.M., Catullo, G., Chapman, R., Cokeliss, Z., Collen, B., Conroy, J., Cooke, J.G., da Fonseca, G.A.B., Derocher, A.E., Dublin, H.T., Duckworth, J.W., Emmons, L., Emslie, R.H., Festa-Bianchet, M., Foster, M., Foster, S., Garshelis, D.L., Gates, C., Gimenez-Dixon, M., Gonzalez, S., Gonzalez-Maya, J.F., Good, T.C., Hammerson, G., Hammond, P.S., Happold, D., Happold, M., Hare, J., Harris, R.B., Hawkins, C.E., Haywood, M., Heaney, L.R., Hedges, S., Helgen, K.M., Hilton-Taylor, C., Hussain, S.A., Ishii, N., Jefferson, T.A., Jenkins, R.K.B., Johnston, C.H., Keith, M., Kingdon, J., Knox, D.H., Kovacs, K.M., Langhammer, P., Leus, K., Lewison, R., Lichtenstein, G., Lowry, L.F., Macavoy, Z., Mace, G.M., Mallon, D.P., Masi, M., McKnight, M.W., Medellin, R.A., Medici, P., Mills, G., Moehlman, P.D., Molur, S., Mora, A., Nowell, K., Oates, J.F., Olech, W., Oliver,

W.R.L., Oprea, M., Patterson, B.D., Perrin, W.F., Polidoro, B.A., Pollock, C., Powel, A., Protas, Y., Racey, P., Ragle, J., Ramani, P., Rathbun, G., Reeves, R.R., Reilly, S.B., Reynolds, J.E., III, Rondinini, C., Rosell-Ambal, R.G., Rulli, M., Rylands, A.B., Savini, S., Schank, C.J., Sechrest, W., Self-Sullivan, C., Shoemaker, A., Sillero-Zubiri, C., De Silva, N., Smith, D.E., Srinivasulu, C., Stephenson, P.J., van Strien, N., Talukdar, B.K., Taylor, B.L., Timmins, R., Tirira, D.G., Tognelli, M.F., Tsytsulina, K., Veiga, L.M., Vie, J.-C., Williamson, E.A., Wyatt, S.A., Xie, Y., Young, B.E., 2008. The status of the World's land and marine mammals: diversity, threat, and knowledge. Science 322, 225-230.

Schwarz, N., Sudman, S., 1992. Context Effects in Social and Psychological Research. Springer-Verlag, New York.

Scott, D.W., Neil, J.S., Paul, B.B., 2001. Probability density estimation, In International Encyclopedia of the Social & Behavioral Sciences. pp. 12095-12099. Pergamon, Oxford.

Seeland, K., Moser, K., Scheuthle, H., Kaiser, F.G., 2002. Public acceptance of restrictions imposed on recreational activities in the peri-urban Nature Reserve Sihlwald, Switzerland. Urban Forestry & Urban Greening 1, 49-57.

Sentencing Council, 2011. Current consultations. [www document]. URL http://sentencingcouncil.judiciary.gov.uk/sentencing/consultations-current.htm. Accessed 10 June 2011.

Sentencing Guidelines Council, 2008. Magistrates' Court Sentencing Guidelines: definitive guideline, p. 198. Crown Copyright, London, UK.

Sergio, F., Newton, I.A.N., Marchesi, L., Pedrini, P., 2006. Ecologically justified charisma: preservation of top predators delivers biodiversity conservation. Journal of Applied Ecology 43, 1049-1055.

Sharp, R., 1997. The African elephant: conservation and CITES. Oryx 31, 111-119.

Sheeran, P., Orbell, S., 1999. Augmenting the theory of planned behavior: roles for anticipated regret and descriptive norms. Journal of Applied Social Psychology 29, 2107-2142.

Shepherd, C., Nijman, V., 2008. The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. Biodiversity and Conservation 17, 35-42.

Sherman, S.J., Presson, C.C., Chassin, L., Corty, E., Olshavsky, R., 1983. The false consensus effect in estimates of smoking prevalence: underlying mechanisms. Personality and Social Psychology Bulletin 9, 197-207.

Shivji, M.S., Chapman, D.D., Pikitch, E.K., Raymond, P.W., 2005. Genetic profiling reveals illegal international trade in fins of the great white shark, (Carcharodon carcharias). Conservation Genetics 6, 1035-1039.

Sieber, J.E., Stanley, B., 1988. Ethical and professional dimensions of socially sensitive research. American Psychologist 43, 49-55.

Sillero-Zubiri, C., Hoffmann, M. and Macdonald, D.W. (compilers). 2004. Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan, p. x + 430. IUCN / SSC Canid Specialist Group., Gland, Switzerland and Cambridge, UK.

Silva, R.S., Vieira, E.M., 2009. Frequency and characteristics of induced abortion among married and single women in São Paulo, Brazil. Cadernos de Saúde Pública, Rio de Janeiro 25, 179-187.

Simons, E.L., Meyers, D.M., 2001. Folklore and beliefs about the aye aye (*Daubentonia madagascariensis*). Lemur News 6, 11-16.

Simonson, P., 2001. Social noise and segmented rhythms: news, entertainment, and celebrity in the crusade for animal rights. The Communication Review 4, 399-420.

Singer, E., Von Thurn, D.R., Miller, E.R., 1995. Confidentiality assurances and response: a quantitative review of the experimental literature. Public Opinion Quarterly 59, 66-77.

Sodhi, N.S., Bickford, D., Diesmos, A.C., Lee, T.M., Koh, L.P., Brook, B.W., Sekercioglu, C.H., Bradshaw, C.J.A., 2008. Measuring the meltdown: drivers of global amphibian extinction and decline. PLoS ONE 3, e1636.

Solomon, J., Jacobson, S.K., Wald, K.D., Gavin, M., 2007. Estimating illegal resource use at a Ugandan park with the randomized response technique. Human Dimensions of Wildlife 12, 75 - 88.

Sommerville, M., Jones, J.P.G., Rahajaharison, M., Milner-Gulland, E.J., 2010. The role of fairness and benefit distribution in community-based payment for environmental services interventions: a case study from Menabe, Madagascar. Ecological Economics 69, 1262-1271.

St. John, F.A.V., Edwards-Jones, G., Gibbons, J.M., Jones, J.P.G., 2010a. Testing novel methods for assessing rule breaking in conservation. Biological Conservation 143, 1025-1030.

St. John, F.A.V., Edwards-Jones, G., Jones, J.P.G., 2010b. Conservation and human behaviour: lessons from social psychology. Wildlife Research 37, 658-667.

Steffen, W., Grinevald, J., Crutzen, P., McNeill, Â J., 2011. The Anthropocene: conceptual and historical perspectives. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 369, 842-867.

Steininger, M.K., Tucker, C.J., Townshend, J.R.G., Killeen, T.J., Desch, A., Bell, V., Ersts, P., 2001. Tropical deforestation in the Bolivian Amazon. Environmental Conservation 28, 127-134.

Stiles, D., Martin, E.B., 2001. Status and trends of the ivory trade in Africa, 1989–1999. Pachyderm 30, 24-36.

Struhsaker, T.T., Struhsaker, P.J., Siex, K.S., 2005. Conserving Africa's rain forests: problems in protected areas and possible solutions. Biological Conservation 123, 45-54.

Stuart, S.N., Chanson, J.S., Cox, N.A., Young, B.E., Rodrigues, A.S.L., Fischman, D.L., Waller, R.W., 2004. Status and trends of amphibian declines and extinctions worldwide. Science 306, 1783-1786.

Sudman, S., Blair, E., Bradburn, N., Stocking, C., 1977. Estimates of threatening behavior based on reports of friends. The Public Opinion Quarterly 41, 261-264.

Sudman, S., Bradburn, N.M., 1982. Asking questions: a practical guide to questionnaire design. Jossey-Bass Inc. Publishers, San Francisco.

Takahashi, M.A., 2009. Overview of the structure and the challenges of Japanese wildlife law and policy. Biological Conservation 142, 1958-1964.

The Scottish Government, 2008. Natural Justice: a joint thematic inspection of the arrangements in Scotland for preventing, investigating and prosecuting wildlife crime p. 52. The Scottish Government, Edinburgh.

Thorn, M., 2009. Carnivores of the North West Province, South Africa: abundance, occupancy and conflict with humans. Thesis, (PhD). University of Brighton.

Titmuss, R.M., 1970. The Gift Relationship: From Human Blood to Social Policy. George Allen and Unwin, London.

Tonglet, M., Phillips, P.S., Read, A.D., 2004. Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. Resources, Conservation and Recycling 41, 191-214.

Tourangeau, R., Yan, T., 2007. Sensitive questions in surveys. Psychological Bulletin 133, 859-883.

Tracy, P.E., Fox, J.A., 1981. The validity of randomized response for sensitive measurements. American Sociological Review 46, 187-200.

Travers, H., Clements, T., Keane, A., Milner-Gulland, E.J., 2011. Incentives for cooperation: the effects of institutional controls on common pool resource extraction in Cambodia. Ecological Economics 71, 151-161.

Treves, A., Karanth, K.U., 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17, 1491-1499.

UK Boarder Agency, 2010. Plot to smuggle valuable rhino horns uncovered. [www document]. URL http://www.ukba.homeoffice.gov.uk/sitecontent/newsarticles/2010/oct/12-smuggle-rhino-horns. Accessed 05 October 2010.

UNEP, 2010. The Convention on Biological Diversity: List of Parties. [www document]. URL http://www.cbd.int/convention/parties/list/. Accessed 05 Feb 2010.

Vallerand, R.J., Deshaies, P., Cuerrier, J.-P., Pelletier, L.G., Mongeau, C., 1992. Ajzen and Fishbein's theory of reasoned action as applied to moral behavior: a confirmatory analysis. Journal of Personality and Social Psychology 62, 98-109.

van den Hout, A., van der Heijden, P.G.M., Gilchrist, R., 2007. The logistic regression model with response variables subject to randomized response. Computational Statistics & Data Analysis 51, 6060-6069.

van Vugt, M., 2009. Triumph of the commons. The New Scientist 203, 40-43.

van Vuuren, D.P., Bouwman, L.F., 2005. Exploring past and future changes in the ecological footprint for world regions. Ecological Economics 52, 43-62.

Venables, W.N., Ripley, B.D., 2002. Modern Applied Statistic with S, 4th edn. Springer-Verlag, New York.

Vlek, C., Steg, L., 2007. Human behavior and environmental sustainability: problems, driving forces, and research topics. Journal of Social Issues 63, 1-19.

Von Hirsch, A., Roberts, J., 2004. Legislating sentencing principles: the provisions of the Criminal Justice Act 2003 relating to sentencing purposes and the role of previous convictions. Criminal Law Review Aug, 639-652.

Wallmo, K., Jacobson, S.K., 1998. A social and environmental evaluation of fuel-efficient cook-stoves and conservation in Uganda. Environmental Conservation 25, 99-108.

Warner, S.L., 1965. Randomized response: a survey technique for eliminating evasive answer bias. Journal of the American Statistical Association 60, 63-69.

Waylen, K.A., McGowan, P.J.K., Pawi Study Group, Milner-Gulland, E.J., 2009. Ecotourism positively affects awareness and attitudes but not conservation behaviours: a case study at Grande Riviere, Trinidad. Oryx 43, 343-351.

Willock, J., Deary, I.J., Edwards-Jones, G., Gibson, G.J., McGregor, M.J., Sutherland, A., Dent, J.B., Morgan, O., Grieve, R., 1999. The role of attitudes and objectives in farmer decision making: business and environmentally-oriented behaviour in Scotland. Journal of Agricultural Economics 50, 286-303.

Williams, S.J., Jones, J.P.G., Clubbe, C., Gibbons, J.M., in review. Training programmes can change behaviour and encourage the cultivation of overharvested plant species.

Wilson-Wilde, L., 2010. Wildlife crime: a global problem. Forensic Science, Medicine, and Pathology 6, 221-222.

Woodroffe, R., Frank, L.G., Lindsey, P.A., ole Ranah, S.M.K., Romañach, S., 2007. Livestock husbandry as a tool for carnivore conservation in Africa's community rangelands: a case–control study, In Vertebrate Conservation and Biodiversity. pp. 419-434. Springer Netherlands.

Wright, V.L., 1980. Use of randomized response technique to estimate deer poaching. Wildlife Society Bulletin 8, 342-344.

Zimmermann, A., Walpole, M.J., Leader-Williams, N., 2005. Cattle ranchers' attitudes to conflicts with jaguar (*Panthera onca*) in the Pantanal of Brazil. Oryx 39, 406-412.

Zubair, M., Garforth, C., 2006. Farm level tree planting in Pakistan: the role of farmers' perceptions and attitudes Agroforestry Systems 66, 217-229.

Appendix 1. Fly fisher surveys

Fly fisher survey protocol

I am PhD student from Bangor University. As part of my research I am testing different methods of asking people questions. I do not record any personal information so you do not need to worry about ending up on any junk mail lists. The survey that I am doing today concerns fly fishing. Please would you take some time to help me by completing this short survey?

Yes

Today I am testing three different methods. Inside the bag there are three balls, each is marked with a different colour which corresponds to a one of three methods. To determine which one you should complete please pick one table tennis ball from this bag and show me what colour mark is on it:

YELLOW = RRT

GREEN = Self-complete

BLUE = Nominative

RRT protocol

OK. You have chosen yellow. This is a fun method that follows rules, as if we were playing a game. First we will do an example. [Give respondent (R) mug with die in it and example Question (Q) card]. The rules of this method ensure that you remain anonymous, I can never trace you answers back to you. Let's do the example. First, put your hand over the top of the mug and shake the die, have a look, what number did it land on? OK, the die has landed on X, now let's read the rules, [read rules off example card]. Your die landed on X, so following the rules you must [complete sentence depending upon result of die throw]. Now, when we do the actual survey you will not tell me, or show me what the die lands on, that is your secret. The only thing that you will say to me is 'Yes' or 'No' by following the rules of the game. I am going to mark your answers on this sheet [show mark sheet to R]. Is that clear to you or would you like to do the example again? [do example again if requested, swopping roles if R seems to lack trust]. Ok, now let's do the survey. Remember to follow the rules, they are written on every card so you do not need to remember them. [Ask RRT Qs 1 – 7]. Thank you, I would just like to finish by asking you a few very short questions – ask Qs 1 – 5 on RRT mark sheet.

Once survey is completed: Thank you, now I have been asking you lots of questions, is there anything you would like to ask me?

Self-complete protocol

Ok. You have chosen green. This method is a quick questionnaire which I will ask you to fill out yourself. You are not required to write your name or other personal details on the questionnaire. I will give you an envelope to seal your completed questionnaire in. Once you have finished, please place your sealed envelope in the locked box. [Give R clip board with questionnaire, pen and envelope. Show R where box is to put completed survey into].

Once R has dropped their envelope into the box: Thank you for taking the time to complete my survey. Do you have any questions you would like to ask me?

Nominative protocol

OK, you have chosen blue. This method is based around you answering questions about your close friends. I am not going to ask you to name them, nor am I going to record your name or personal details. I am now going to ask you a series of questions and I will record the answers on this form. It will only take us a few minutes to complete this survey [start nominative questionnaire].

Once survey is completed: Thank you, now I have been asking you lots of questions, is there anything you would like to ask me?

NOTE: The font sizes of the RRT cards and surveys show within this Appendix have been reduced for the purpose of inclusion in this thesis. Actual RRT cards and surveys were produced in larger font sizes so that they were easy for respondents to read.

Appendix 1

DATASHEET for RRT respondents only

Interview number: _____ Date: _____ Location: _____

RRT responses (place a tick in appropriate box to mark response)

	Yes	No			
1			1	Respondent is male or female?	
2			2	What year were you born?	
3			3	How often do you fish here? (e.g. once a week, twice a month etc)	
4			4	How many other fisheries in North Wales do you fly fish at?	
5			5	What is the first section of your postcode?	
6					
7					

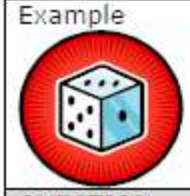
DATASHEET for RRT respondents only

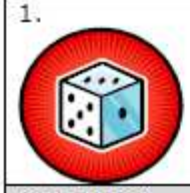
Interview number: _____ Date: _____ Location: _____

RRT responses (place a tick in appropriate box to mark response)

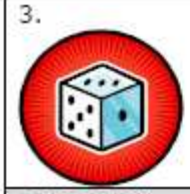
	Yes	No			
1			1	Respondent is male or female?	
2			2	What year were you born?	
3			3	How often do you fish here? (e.g. once a week, twice a month etc)	
4			4	How many other fisheries in North Wales do you fly fish at?	
5			5	What is the first section of your postcode?	
6					
7					

There is no way I can trace your answers back to you. You remain completely anonymous.

Example 	INSTRUCTIONS Please shake the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say 'Yes' 6= say 'No'
QUESTION:	In the last 12 months did you ever drive 40 mph or faster in a 30 mph zone?

1. 	INSTRUCTIONS Please shake the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say 'Yes' 6= say 'No'
QUESTION	In the last 12 months did you ever fly fish without an Environment Agency rod license?

2. 	INSTRUCTIONS Please roll the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say Yes 6= say No
QUESTION:	In the last 12 months did you ever fish without a valid day permit?

3. 	INSTRUCTIONS Please roll the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say Yes 6= say No
QUESTION:	In the last 12 months did you ever take undersized fish?

4. 	INSTRUCTIONS Please roll the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say Yes 6= say No
QUESTION:	In the last 12 months did you ever exceed the bag limit?

5. 	INSTRUCTIONS Please shake the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say 'Yes' 6= say 'No'
QUESTION:	In the last 12 months did you fish with a live bait in a fly only water?

6. 	INSTRUCTIONS Please shake the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say 'Yes' 6= say 'No'
QUESTION:	In the last 12 months did you ever illegally take brown trout?

7. 	INSTRUCTIONS Please shake the die – do not let me see what it lands on Remember the rules: 1, 2, 3, 4 answer the question below truthfully 'Yes' or 'No' 5 = say 'Yes' 6= say 'No'
QUESTION:	In the last 12 months did you ever exceed the bag limit at this site?

NOMINATIVE QUESTIONNAIRE

Interview number: _____ Date: _____ Location: _____

1	Respondent is male or female?	
2	What year were you born?	
3	How often do you fish here? (e.g. once a week, twice a month etc)	
4	How many other fisheries in North Wales do you fly fish at?	
5	What is the first section of your postcode?	

6	Most of us know many people. But usually only a few, if any, of these are close friends. **About how many of your close friends go fly fishing?** _____ number of close friends who go fly fishing.

If answer to Q. 6 is 0, end interview here.

7	This question is about your close friends. Keep their names to yourself. We want to know about them, but we do not want to know who they are. **How many of your close friends who go fly fishing can you say for sure have broken fly fishing rules in the last year?** _____ number of close friends who have broken fly fishing rules in the last year.

If answer to Q. 7 is 0, end interview here.
If only 1 friend reported in Q7. **go to Q8. directly.**
If more than 1 friend reported in Q7. **apply randomised selection:**

Give respondent piece of card and pen. Ask them to list the initials of their close friends on the card (this information will never be seen by the interviewer). Ask respondent to number each set of initials on the list from 1 onwards to the end. Using the following rule, inform respondent of which numbered friend they should answer questions 8 – 16 about.
Circle number of person being asked about.

If the number of close friends in Q1. Is	*Ask about friend number*
2	*2*
3	*3*
4	*2*
5	*1*
6+	*6*

Please answer the following questions with respect to your close friend that you are thinking of.

8	Is this person male or female?	
9	How old is this person now?	(indicate if estimate or known age)
10	As far as you know, how often do they fish here? (e.g. once a week, twice a month etc)	
11	As far as you know how many other fisheries in North Wales do they fly fish at?	
12	Where do they live now? (Nearest town)	

	Question	Yes	No
13	As far as you know in the last 12 months did your friend ever fly fish without an Environment Agency rod license?		
14	As far as you know in the last 12 months did your friend ever fish without a valid day permit?		
15	As far as you know in the last 12 months did your friend ever take undersized fish?		
16	As far as you know in the last 12 months did your friend ever exceed the bag limit?		
17	As far as you know in the last 12 months did your friend fish with a live bait in a fly only water?		
18	As far as you know in the last 12 months did your friend ever illegally take brown trout?		
19	As far as you know in the last 12 months did your friend ever exceed the bag limit at this site?		

20	There are many different ways of you knowing that you friend has broken fly fishing rules. Please tell us how you know that your friend has broken these rules. (write response verbatim)

Now we would like you to think about this friend's other close friends, besides yourself.

21	As far as you know, how many of this person's close friends, besides yourself, know for sure that this person has broken fly fishing rules in the last year? _____ Number of other close friends knowing. Answer must be a number or write 'don't know'.

End of nominative questionnaire.

This self-complete survey is completely anonymous

After completing please seal in envelope provided and drop it into the locked box.

1. In the last 12 months did you ever fly fish without an Environment Agency rod license?

Please circle your answer

Yes **No**

2. In the last 12 months did you ever fish without a valid day permit?

Please circle your answer

Yes **No**

3. In the last 12 months did you ever take undersized fish?

Please circle your answer

Yes **No**

4. In the last 12 months did you ever exceed the bag limit?

Please circle your answer

Yes **No**

5. In the last 12 months did you ever fish with a live bait in a fly only water?

Please circle your answer

Yes **No**

6. In the last 12 months did you ever illegally take brown trout?

Please circle your answer

Yes **No**

7. In the last 12 months did you ever exceed the bag limit at this site?

Please circle your answer

Yes **No**

8	Are you male or female?	
9	In what year were you born?	
10	How often do you fish here? (e.g. once a week, twice a month etc)	
11	How many other fisheries in North Wales do you fly fish at?	
12	What is the first section of your postcode?	

Thank you for participating in my survey. Please do not hesitate to ask me any questions you may have.

Appendix 2. South Africa farmer / rancher survey

RRT														
Date			Interview location:									Interview number:		
												Interviewer:		
RRT answers (tick to mark answer)														
	Yes	No		Yes	No		Yes	No		Yes	No		Yes	No
1			3			5			7			9		
2			4			6			8			10	Gender:	

	Please complete the following questions	
11	What year were you born?	
12	Ranch location: Province	
13	Ranch location: Local area	
14	Ranch type:	Cattle Mixed livestock Game Cattle & Game Other (please specify) _____
15	Position on ranch:	Owner Manager Worker
16	Number of years in ranching:	
17	Please state your ethnicity for example Afrikaans, Tswana etc.	

	Do you think the questions below would make **MOST FARMERS FEEL:** very uneasy, moderately uneasy, slightly uneasy or not at all uneasy?	PLEASE TICK			
		very uneasy	moderately uneasy	slightly uneasy	not at all uneasy
18	In the last 12 months did you kill any snakes?				
19	In the last 12 months did you kill any jackals?				
20	In the last 12 months did you kill any brown hyaenas?				
21	In the last 12 months did you kill any caracals?				
22	In the last 12 months did you kill any leopards?				
23	In the last 12 months did you use poison to control predators?				
24	In the last 12 months did you kill any predators without the required permit from the Local Wildlife Authority?				

	For each animal please indicate **how much YOU agree or disagree** with this statement: • These days I think that **this animal** is a pest and that they should be killed on ranches					
	Animal	**Strongly disagree**	**Disagree**	**I cannot decide**	**Agree**	**Strongly agree**
25	Snake					
26	Jackal					
27	Brown Hyaena					
28	Caracal					
29	Leopard					

	There are 3 penalties for killing animals without a permit from the Local Wildlife Authority. Please tick which penalty you think applies to the animals listed.		
		PLEASE TICK	
		R 100,000 fine; or Maximum of 5 years in prison	**No penalty**
30	Snake		
31	Jackal		
32	Brown Hyaena		
33	Caracal		
34	Leopard		

	Out of 10 farmers, how many do you think have killed the following animals in the last 12 months?	
		WRITE A NUMBER BETWEEN 0 and 10 BELOW
35	Snake	
36	Jackal	
37	Brown Hyaena	
38	Caracal	
39	Leopard	
40	Out of 100 farmers, how many do you think used poison to control predators in the last 12 months?	
41	Out of 100 farmers, how many do you think killed predators without the required Local Wildlife Authority permit in the last 12 months?	

	For each animal please indicate **how much YOU agree or disagree** with this statement: • These days I think that **this animal** is emblematic of South Africa and that killing them on ranches is wrong.					
	Animal	**Strongly disagree**	**Disagree**	**I cannot decide**	**Agree**	**Strongly agree**
42	Snake					
43	Jackal					
44	Brown Hyaena					
45	Caracal					
46	Leopard					

Thank you for taking the time to complete this survey.

Appendix 2

EXAMPLE	INSTRUCTIONS
	Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you ever drive 140km or faster on a 120km per hour road?

1.	INSTRUCTIONS
	Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any snakes?

2.	INSTRUCTIONS
	Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any jackals?

3.	INSTRUCTIONS
	Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any brown hyaenas?

4.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any caracals?

5.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any leopards?

6.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill 2 or more brown hyaenas?

7.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill 2 or more leopards?

8.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you use poison to control predators?

9.	INSTRUCTIONS Please shake the two dice – do not let me see what they land on Remember the rules, add together the numbers on the two dice: 2, 3, 4 = say 'Yes' 5 – 10 answer the question below truthfully 'Yes' or 'No' 11, 12 = say 'No'
QUESTION	In the last 12 months did you kill any predators without the required permit from the Local Wildlife Authority

Appendix 3. Model selection, supplementary material

Section 1

The generalised linear mixed-effects model (GLMM) upon which our results are based was fitted by penalised quasi-likelihood (PQL) using the glmmPQL function from the MASS package (Venables and Ripley 2002) in R version 2.12.0 (R Development Core Team 2010) with a custom link function. This choice was dictated by several considerations:

We wished to be able to use mixed-effect models since they are generally able to make more efficient use of grouped data than alternative approaches which analyse such data separately (see Gelman and Hill (2007), for a discussion).

Any model of data arising from randomised response surveys must account for the bias and additional variation introduced by the random responses (van den Hout et al. 2007). To the best of our knowledge, none of the standard statistical packages currently includes functions which are able to do this.

Following van den Hout et al. (2007), we chose to take advantage of R's flexible nature to modify an existing model-fitting function to accept RRT data: glmmPQL is one of the few available functions for fitting GLMMs which can readily be modified to accept the custom link function required to analyse RRT data (Venables and Ripley 2002).

Although PQL is a flexible approach and has been widely applied, the use of quasi-likelihood drastically constrains the options that are available for model selection. The most widely accepted criteria for model selection – likelihood ratio tests and AIC – both require models which produce true likelihoods. Analogues based on quasi-likelihoods, such as quasi-AIC, have been suggested (see e.g. Lebreton et al., 1992; Richards, 2007), but lack a solid theoretical basis.

We therefore adopted a procedure where we first fit a series of GLMs separately for each species. AIC was calculated for each model and the models were ranked within each species set. The best fitting model was considered to be the one with the smallest AIC value (Burnham and Anderson 2002). The structures of best fitting models for each species and their effect estimates were then compared. If they had differed significantly we would have concluded that different structures were appropriate for each species and drawn inferences from the single-species models.

However, in this case the structures of the best fitting models were identical so we proceeded to fit a GLMM with this fixed effect structure and a random effect for the individual respondent, using data from all four species together. Finally, we compared the effect estimates derived from the fitted GLMM to those obtained from the single species GLMs as a simple check on the robustness of our findings. Gelman and Hill (2007) suggest that a series of GLMs such as this is analogous to an extreme case of a GLMM in which there is no "pooling" of information within the grouping variable (in this case, the individual respondent). We observed a reasonably close match between the results of the GLMs and the GLMM, suggesting that the degree of pooling was relatively low. In addition, by selecting the model structure based upon the single species GLMs (which were each fitted using only a quarter of the total data) we believe that the selected model will tend to be conservative in terms of model complexity. This approach, although ad hoc, was chosen as a pragmatic compromise between the desire to make efficient use of the data and the limitations of the available software.

Table 1. Generalised linear model selection using Akaike's Information Criterion

	Attitude towards killing	Farmers' estimates of peer-behaviour	Question sensitivity	Leopard Δ AIC	Caracal Δ AIC	Jackal Δ AIC	Snake Δ AIC
Model 1	Y	Y	Y	0	0	0	0
Model 2	X	Y	Y	2.90	2.97	3.81	3.19
Model 3	Y	Y	X	5.49	7.16	6.24	5.05
Model 4	X	Y	X	10.03	9.69	8.20	9.38
Model 5	Y	X	Y	16.39	9.43	11.77	2.59
Model 6	X	X	Y	18.81	13.28	18.29	6.74
Model 7	Y	X	X	20.87	17.04	17.90	9.40

Appendix 3

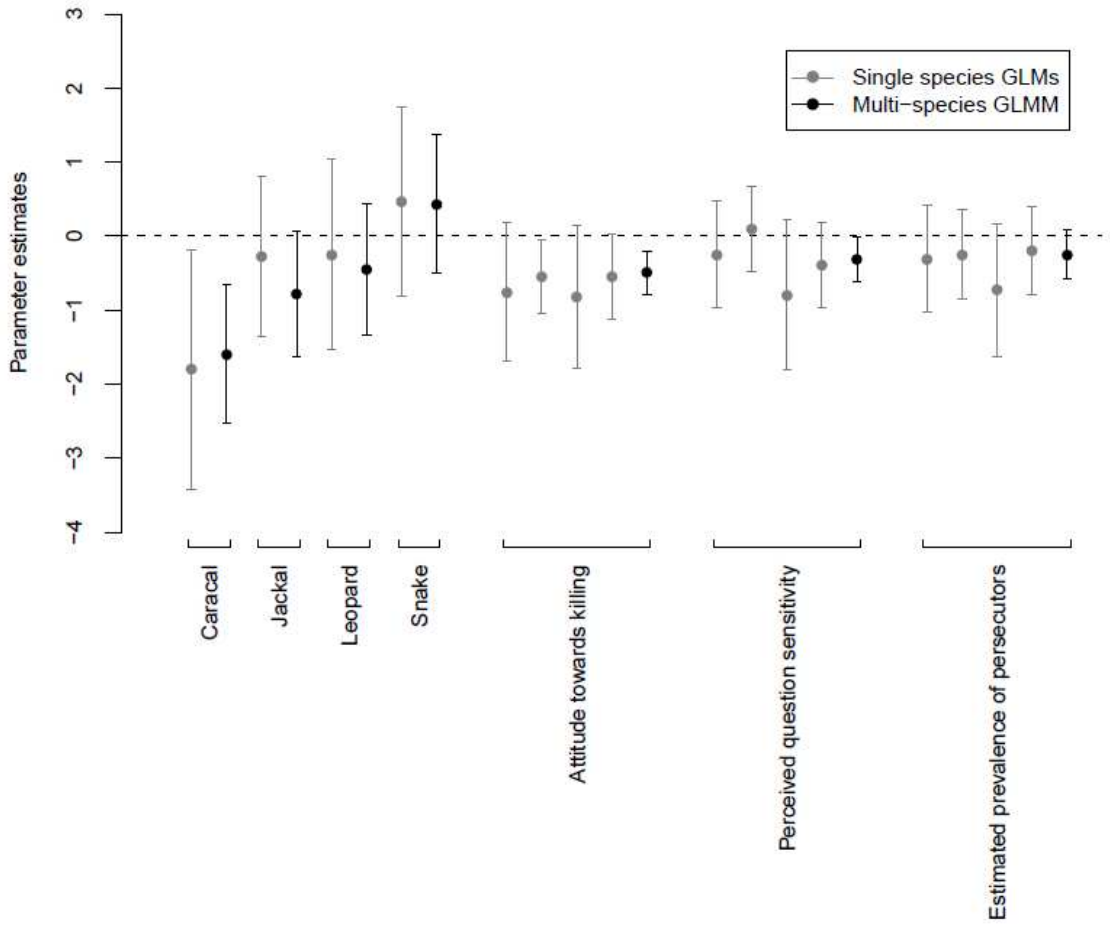


Figure 1. Parameter estimates for single species generalised linear models and the generalised linear mixed model incorporating all species and respondents' identity as a random effect. Positive parameter estimates correspond to a higher probability that a species would be killed by a farmer. Error bars represent 95% confidence intervals.

References

Burnham, K.P., Anderson, D.R., 2002. Model Selection and Multimodel Inference: a practical information-theoretic approach, 2nd edn. Springer-Science+Business Media, Inc., New York.

Gelman, A., Hill, J., 2007. Data Analysis Using Regression and Multilevel / Hierarchical Models, 1st edition edn. Cambridge University Press, New York, USA.

Lebreton, J.-D., Burnham, K.P., Clobert, J., Anderson, D.R., 1992. Modeling survival and testing biological hypotheses using marked animals: A unified approach with case studies. Ecological Monographs 62, 67-118.

R Development Core Team, 2010. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.

Richards, S.A., 2007. Dealing with overdispersed count data in applied ecology. Journal of Applied Ecology 45, 218-227.

van den Hout, A., van der Heijden, P.G.M., Gilchrist, R., 2007. The logistic regression model with response variables subject to randomized response. Computational Statistics & Data Analysis 51, 6060-6069.

Venables, W.N., Ripley, B.D., 2002. Modern Applied Statistic with S, 4th edn. Springer-Verlag, New York.

Appendix 4. Wildlife trade crime survey

Wildlife trade

Globally the legal trade in wild animals and their by-products (for example animals traded as pets, leather goods, tourist curios and medicines) provides work and income for many people. This global trade is regulated to ensure that it does not threaten species' survival in the wild. This means that the trade in many species requires permits, and that the trade in some species is banned altogether. Species are considered differently depending on the protection they need.

Group I: Trade allowed only in exceptional circumstances.
Group II: Trade allowed, permits always required.
Group III: Trade allowed, permits occasionally required.

Some people break the law and trade wildlife illegally, often making considerable amounts of money. This illegal trade threatens the existence of some species. Here are some examples of the types of animals that are traded, sometimes illegally.

Birds		
		
Peregrine falcon www.ukfalcons.com	**African grey parrot** www.parrotarchive.blogspot.com	**Wild bird eggs** www.news.minnesota.publicradio.org
Fish		
		
Asian arawana www.arowana.asia	**Sea horses** www.govloop.com	**Caviar** www.en.rian.ru
Reptiles		
		
Hermann's tortoise www.mwilsonherps.wordpress.com	**Royal python** www.blog.luciolepress.com	**Snake skin leather goods** www.siamtradingpost.com www.fashionyou.com
Mammals		
		 Tiger bone medicine packet
Elephant F. A. V. St. John	**Wolf** www.laughing1wolf.blogspot.com	**Tiger** www.forevertigers.com

The Survey

We want to understand which aspects of this illegal trade you think are the most important when considering what sentence someone should be given by a court of law. We will present pairs of wildlife trade offences to you. You will be asked to indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

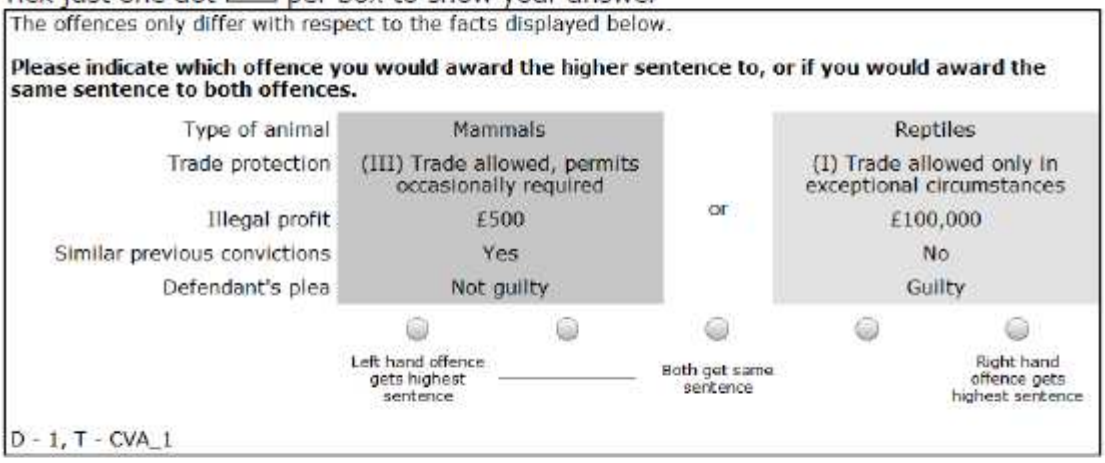
You will be shown the following details about every offence:

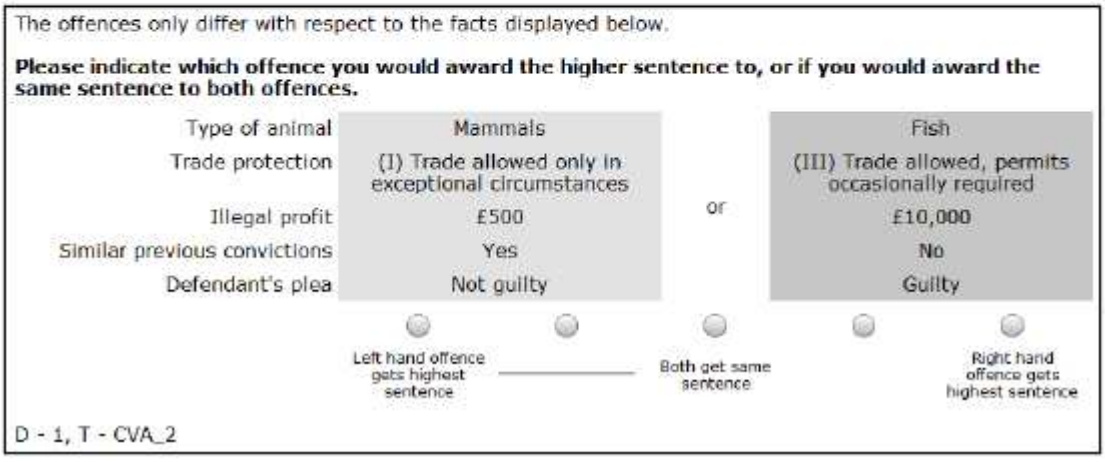
1. The type of wild animals that the defendant has been found to be trading illegally;
2. The level of protection given to the items found in the defendant's possession;
3. Illegal profit made;
4. If the defendant has any previous convictions for similar offences;
5. The defendant's plea (guilty or not guilty).

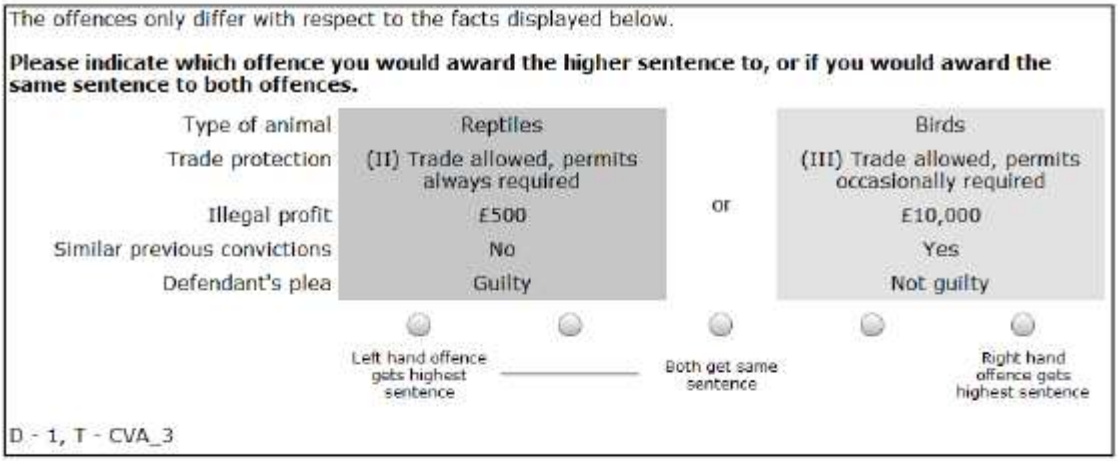
There are no right or wrong answers; we are simply interested in what you think.

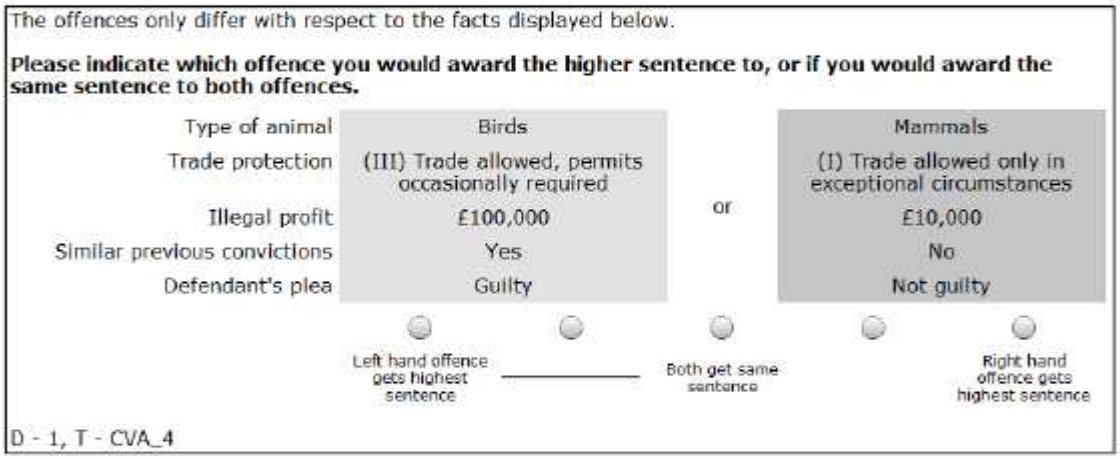
All of the information you provide remains anonymous.

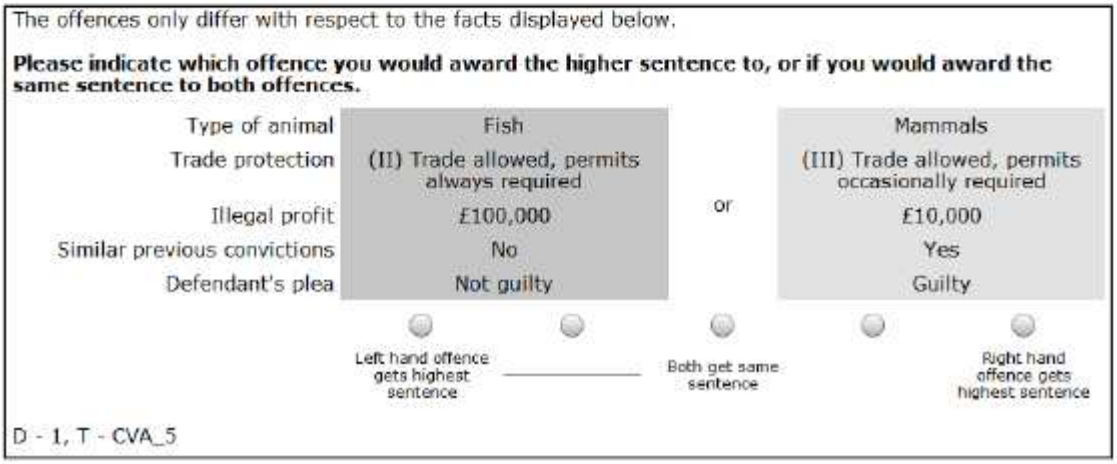
Tick just one dot per box to show your answer

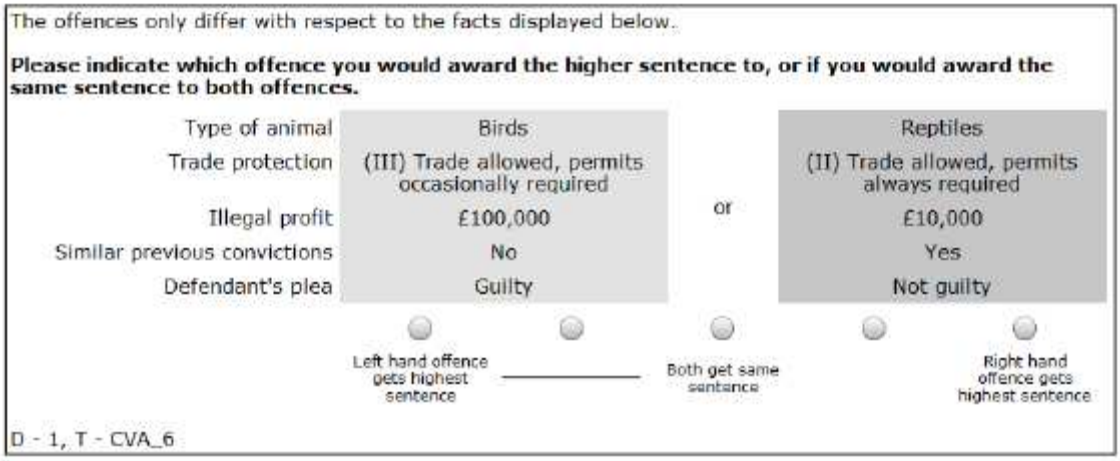


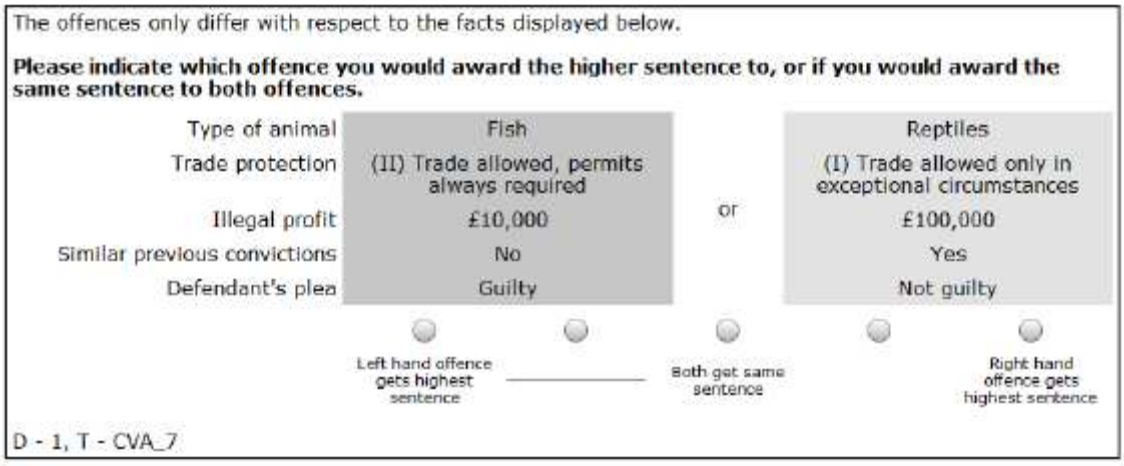


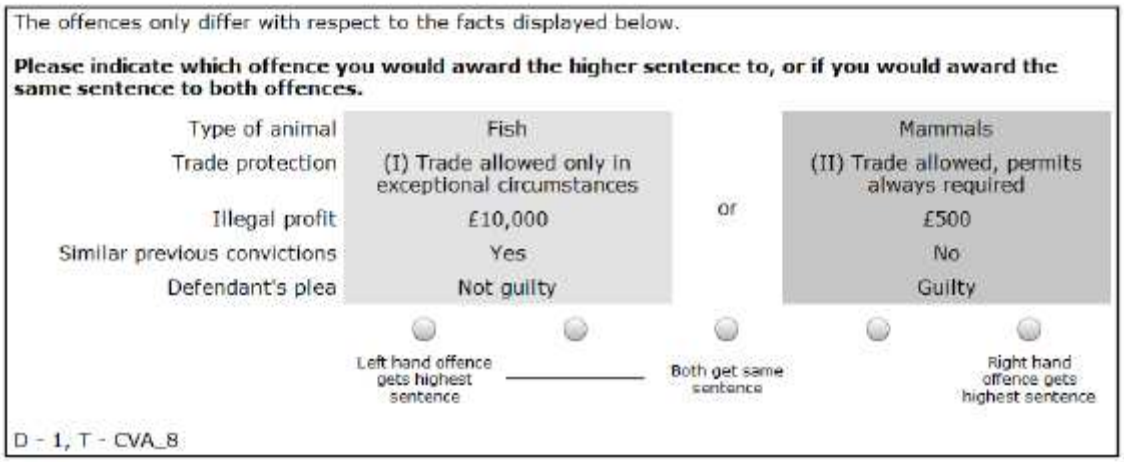

The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Reptiles
(II) Trade allowed, permits always required
£500
No
Guilty
or
Birds
(III) Trade allowed, permits occasionally required
£10,000
Yes
Not guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_3

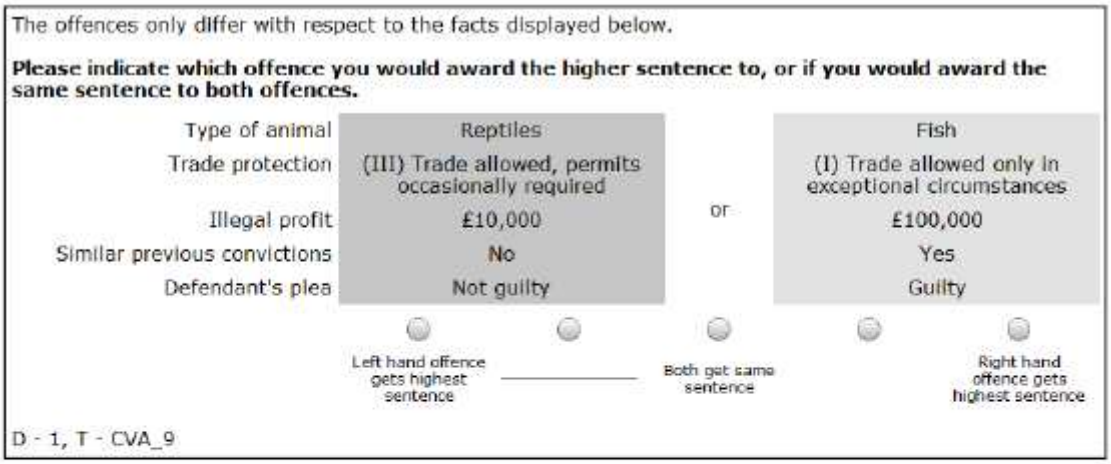

The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Birds
(III) Trade allowed, permits occasionally required
£100,000
Yes
Guilty
or
Mammals
(I) Trade allowed only in exceptional circumstances
£10,000
No
Not guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_4


The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Fish
(II) Trade allowed, permits always required
£100,000
No
Not guilty
or
Mammals
(III) Trade allowed, permits occasionally required
£10,000
Yes
Guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_5


The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Birds
(III) Trade allowed, permits occasionally required
£100,000
No
Guilty
or
Reptiles
(II) Trade allowed, permits always required
£10,000
Yes
Not guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_6


The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Fish
(II) Trade allowed, permits always required
£10,000
No
Guilty
or
Reptiles
(I) Trade allowed only in exceptional circumstances
£100,000
Yes
Not guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_7


The offences only differ with respect to the facts displayed below.
Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.
Type of animal
Trade protection
Illegal profit
Similar previous convictions
Defendant's plea
Fish
(I) Trade allowed only in exceptional circumstances
£10,000
Yes
Not guilty
or
Mammals
(II) Trade allowed, permits always required
£500
No
Guilty
Left hand offence gets highest sentence
Both get same sentence
Right hand offence gets highest sentence
D - 1, T - CVA_8

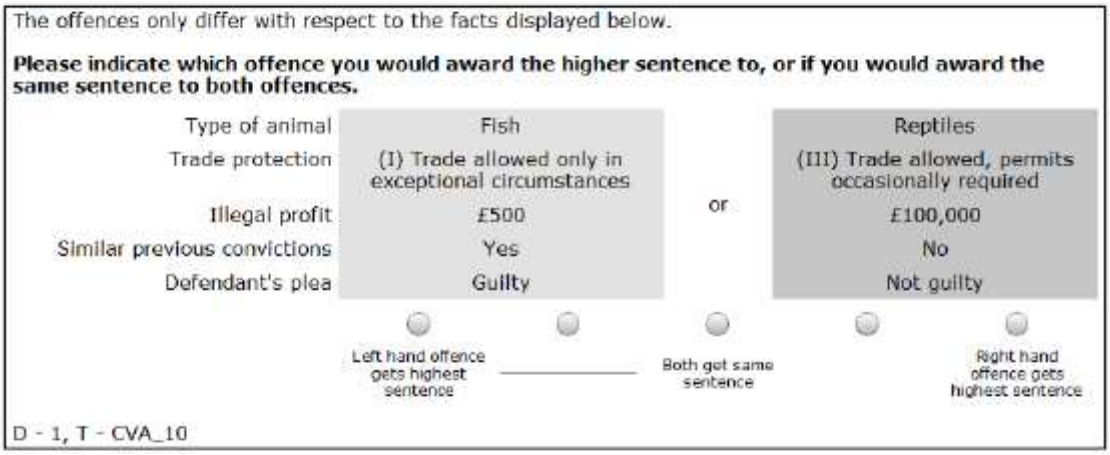

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Reptiles		Fish
Type of animal			
Trade protection	(III) Trade allowed, permits occasionally required		(I) Trade allowed only in exceptional circumstances
Illegal profit	£10,000	or	£100,000
Similar previous convictions	No		Yes
Defendant's plea	Not guilty		Guilty

Left hand offence gets highest sentence — Both get same sentence — Right hand offence gets highest sentence

D - 1, T - CVA_9

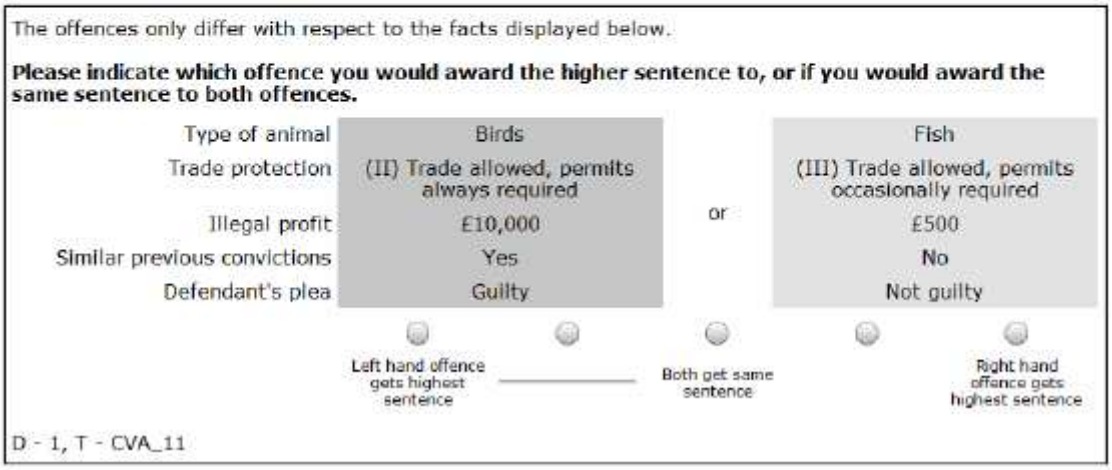

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Fish		Reptiles
Type of animal			
Trade protection	(I) Trade allowed only in exceptional circumstances		(III) Trade allowed, permits occasionally required
Illegal profit	£500	or	£100,000
Similar previous convictions	Yes		No
Defendant's plea	Guilty		Not guilty

Left hand offence gets highest sentence — Both get same sentence — Right hand offence gets highest sentence

D - 1, T - CVA_10

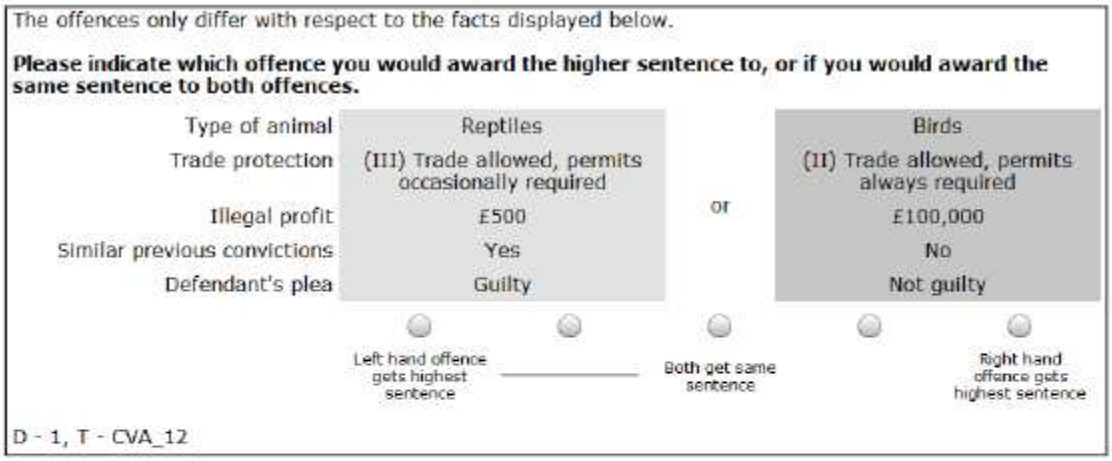

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Birds		Fish
Type of animal			
Trade protection	(II) Trade allowed, permits always required		(III) Trade allowed, permits occasionally required
Illegal profit	£10,000	or	£500
Similar previous convictions	Yes		No
Defendant's plea	Guilty		Not guilty

Left hand offence gets highest sentence — Both get same sentence — Right hand offence gets highest sentence

D - 1, T - CVA_11

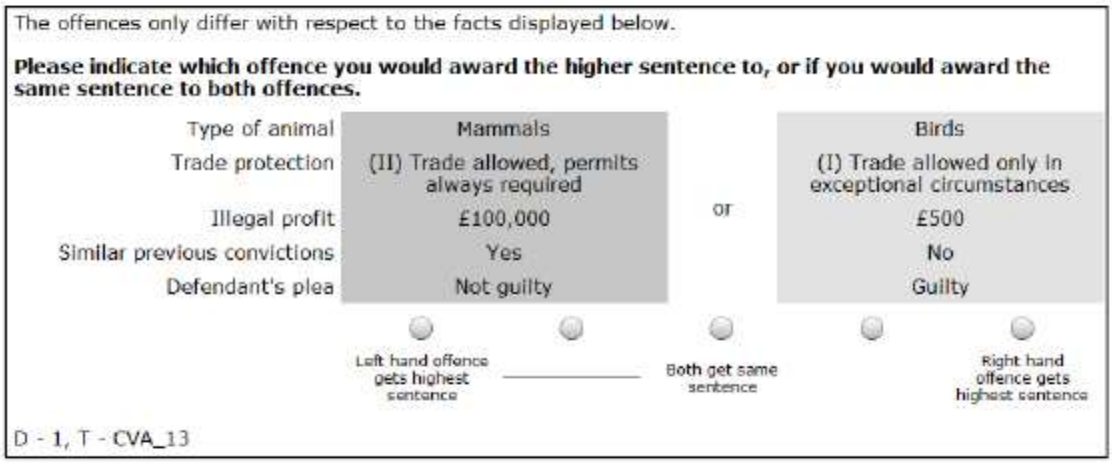

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Reptiles		Birds
Type of animal			
Trade protection	(III) Trade allowed, permits occasionally required		(II) Trade allowed, permits always required
Illegal profit	£500	or	£100,000
Similar previous convictions	Yes		No
Defendant's plea	Guilty		Not guilty

Left hand offence gets highest sentence | Both get same sentence | Right hand offence gets highest sentence

D - 1, T - CVA_12

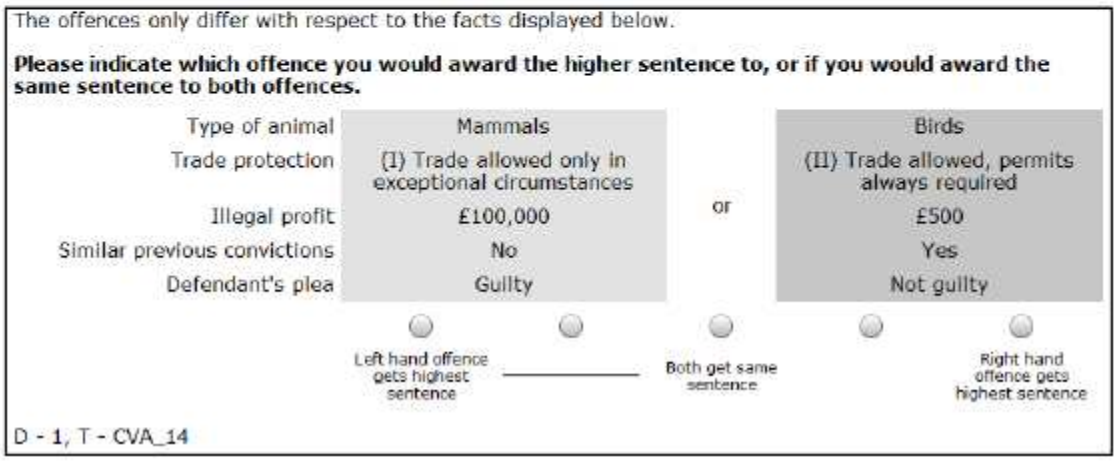

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Mammals		Birds
Type of animal			
Trade protection	(II) Trade allowed, permits always required		(I) Trade allowed only in exceptional circumstances
Illegal profit	£100,000	or	£500
Similar previous convictions	Yes		No
Defendant's plea	Not guilty		Guilty

Left hand offence gets highest sentence | Both get same sentence | Right hand offence gets highest sentence

D - 1, T - CVA_13

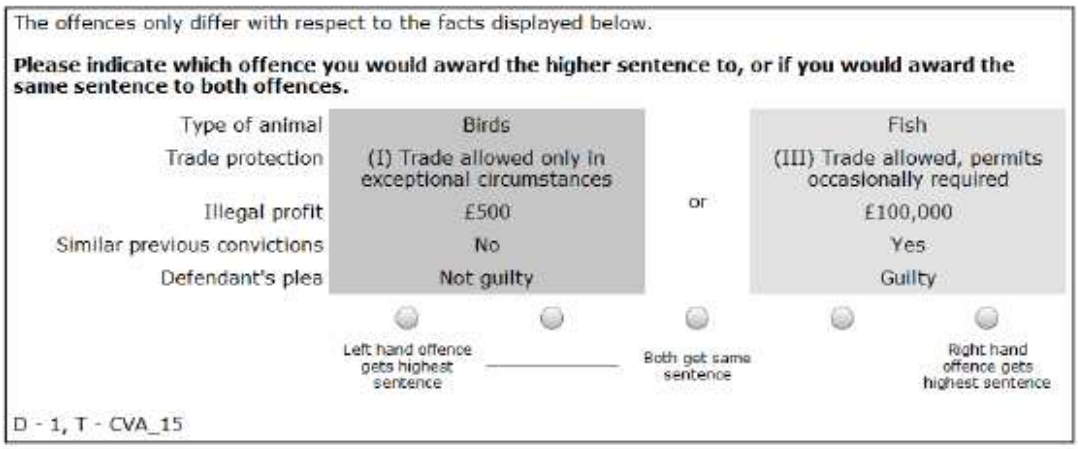

The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Mammals		Birds
Type of animal			
Trade protection	(I) Trade allowed only in exceptional circumstances		(II) Trade allowed, permits always required
Illegal profit	£100,000	or	£500
Similar previous convictions	No		Yes
Defendant's plea	Guilty		Not guilty

Left hand offence gets highest sentence | Both get same sentence | Right hand offence gets highest sentence

D - 1, T - CVA_14


The offences only differ with respect to the facts displayed below.

Please indicate which offence you would award the higher sentence to, or if you would award the same sentence to both offences.

	Birds		Fish
Type of animal	Birds		Fish
Trade protection	(I) Trade allowed only in exceptional circumstances	or	(III) Trade allowed, permits occasionally required
Illegal profit	£500		£100,000
Similar previous convictions	No		Yes
Defendant's plea	Not guilty		Guilty

Left hand offence gets highest sentence — Both get same sentence — Right hand offence gets highest sentence

D - 1, T - CVA_15


	Fish	Birds	Mammals	Reptiles
	(I) Trade allowed only in exceptional circumstances Illegal profit £500 Has similar previous convictions Pleaded not guilty	(II) Trade allowed, permits always required Illegal profit £10,000 No previous convictions Pleaded not guilty	(II) Trade allowed, permits always required Illegal profit £10,000 Has similar previous convictions Pleaded guilty	(III)Trade allowed, permits occasionally required Illegal profit £100,000 No previous convictions Pleaded guilty
Which would you award the highest sentence to? (please tick one)				

We need some information to check that we have interviewed a broad range of people. **All information is anonymous and confidential.**

Q1. Are you male ____ or female ____ (please tick)	**Q2. What year where you born?** _____
Q3. Home postcode: _____ (only used to know if you live in a rural or urban area)	

Q.4 Which is the highest level of qualification that you have?	Please tick
No qualifications	
1+'O' level passes; 1+ CSE/GCSE any grades; NVQ level 1; or Foundation level GNVQ	
5+'O' level passes; 5+ CSE (grade 1's); 5+GCSEs (grades A-C); School Certificate; 1+'A' levels/'AS' levels; NVQ level 2; or Intermediate GNVQ	
2+ 'A' levels; 4+ 'AS' levels; Higher School Certificate; NVQ level 3; or Advanced GNVQ	
First Degree, Higher Degree, NVQ levels 4 and 5; HNC; HND; Qualified Teacher Status; Qualified Medical Doctor; Qualified Dentist; Qualified Nurse; Midwife; or Health Visitor	
Level unknown	

Q5. Please could you indicate <u>your</u> total personal income (before tax) (Please tick one box)					
Up to £5,999		£15,000 – £19,999		£50,000 and over	
£6,000 - £9,999		£20,000 – £29,999			
£10,000 - £14,999		£30,000 – £49,999			

Q6. Which of these best describes your job? (Please tick)			
Agriculture; hunting; forestry		Financial intermediation	
Fishing		Real estate; renting; and business activities	
Mining & quarrying		Public administration and defence	
Manufacturing		Employed in education	
Electricity; gas; and water supply		Health and social work	
Construction		Retired	
Wholesale & retail trade; repair of motor vehicles		Unemployed	
Hotels and catering		Full time student	
Transport; storage; and communication		Other (please specify)	

Q7. Are you a nature conservation practitioner / professional?	Yes	No	(please circle)

Q8. Are you a member, or do you donate money to any conservation organisation? (e.g. RSPB, Wildlife Trust, WWF) Please name all of them:			
		None: (please tick)	

Q9. Do you keep any pets? (Please tick all that apply to you)					
Mammals: (dogs, cats, rabbits etc)		Bird(s)			
Reptiles: (snakes, tortoises, lizards etc)		Fish		None:	
Other (please specify)					

Q10. Have you ever been to court:	As a juror	Yes	No
	As a defendant	Yes	No
	As a witness	Yes	No

Thank you very much for taking the time to complete this survey.

F. St. John, School of Environment,
Natural Resources and Geography,
Bangor University.

Appendix 5. EU wildlife trade annexes and CITES

The European Union Wildlife Trade Regulation (EC) No. 338/97 Annexes and related CITES Appendices

EU Annex	EU Annex includes:	Notes on CITES Appendices
Annex A Import permits required at first point of introduction to the EU. Export or re-export permits required, when exporting outside of the EU.	All CITES Appendix I species. Some CITES Appendix II and III species, for which the EU has adopted stricter domestic measures. Some non-CITES species.	**Appendix I:** lists species that are the most endangered among CITES-listed animals and plants. CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. In these exceptional cases, trade may take place provided it is authorised by the granting of both an import permit and an export permit, or re-export certificate.
Annex B Import permits required at first point of introduction to the EU. Export or re-export permits required, when exporting outside of the EU.	All other CITES Appendix II species. Some CITES Appendix III species. Some non-CITES species.	**Appendix II:** lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. International trade in specimens of Appendix II species may be authorised by the granting of an export permit or re-export certificate. No import permit is required but importation is only permitted if a valid export permit or re-export certificate exists (although some countries have stricter measures than CITES requires).
Annex C Certificate of origin required at first point of introduction to the EU. Export or re-export permits required, when exporting outside of the EU.	All other CITES Appendix III species.	**Appendix III:** lists species at the request of Parties already regulating trade in the species and needs the cooperation of other countries to prevent unsustainable or illegal exploitation. Exporting Appendix III specimens from a state where they are included on Appendix III requires an export permit; importation requires a certificate of origin. Re-export certificate also needed if specimen is to be re-exported.
Annex D Import notifications required at first	Some CITES Appendix III species for which the EU holds a reservation.	Parties to CITES can enter 'reservations' with respect to any species listed in the Appendices.

point of introduction to the EU.	Some non-CITES species.